

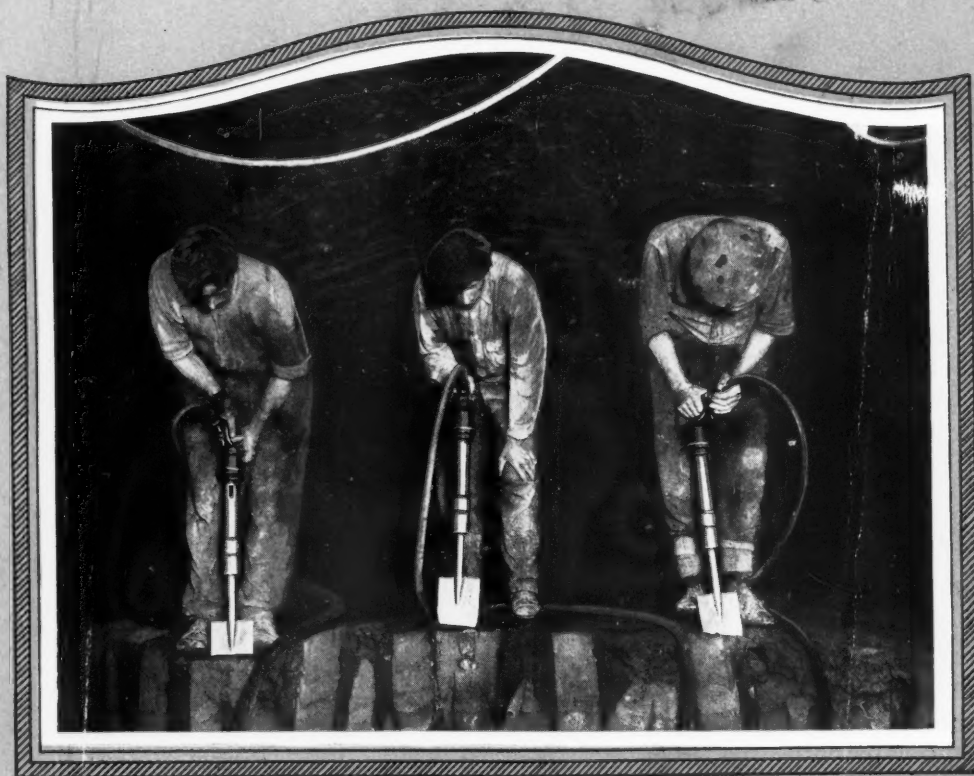
Engineering
Library

JUN 5 1922

Compressed Air Magazine

Vol. XXVII, No VI London New York Paris 35 Cents a Copy

JUNE, 1922
CIRCULATION THIS ISSUE
14,200 COPIES



*"LITTLE DAVID" PNEUMATIC CLAY DIGGERS PICKING HARD
CLAY IN A SEWER TUNNEL HEADING IN DETROIT*

**Compressed Air Applied to
The Foundry**

Richard Hoadley Tingley

**Pneumatic Clay Diggers Speed
Sewer Tunnel Work**

R. A. Lundell

**Pneumatic Tools in Foundry
Practice**

James W. Anderson

**American Salvors Re-establish
Their Pre-eminence**

Robert G. Skerrett

(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 5)



The Great Rajasamand Dam

The ruler of Rajputana, in the heart of India, began the great dam "Rajasamand" in 1661. This vast pile of white polished marble, hidden so well in the Aravalli Mountains, has remained almost unknown for generations. It is a colossal monument to these early engineers.

Twenty years were consumed in building the dam; hammers and chisels were used for cutting the rocks; large sharp hoes for excavating earth. Workmen, commanded by the Rajah, moved "in that leisurely but regular procession peculiar to the East, where time is not and obedience is law".

It is doubtful whether modern engineers can build a better structure; but today they must also consider costs. Explosives have made possible the building of dams larger than Rajasamand and equally as enduring, with much less labor and in less than one-

tenth the time; but even explosives—one of man's greatest cost-reducing inventions—must now be carefully compared and chosen.

For reducing blasting costs, we have for several years recommended Hercules Special No. 1 on work for which it is suited. This dynamite contains nothing but the highest grade of standard materials and by wide use has proved its dependability. Special No. 1 replaces 35% and 40% cartridge for cartridge, but, because of its higher cartridge-count, costs less per cartridge than 15% dynamite. No high explosive on the market is more economical than Hercules Special No. 1.

If you are interested in the elimination of waste, write to our advertising department, 932 King Street, Wilmington, Delaware, for our booklet, Volume vs. Weight—A Lesson in Explosives Economy.

HERCULES

POWDER COMPANY

Allentown, Pa.
Birmingham, Ala.
Buffalo, N. Y.
Chattanooga, Tenn.

Chicago, Ill.
Denver, Colo.
Duluth, Minn.

Hazleton, Pa.
Huntington, W. Va.
Joplin, Mo.
Los Angeles, Cal.



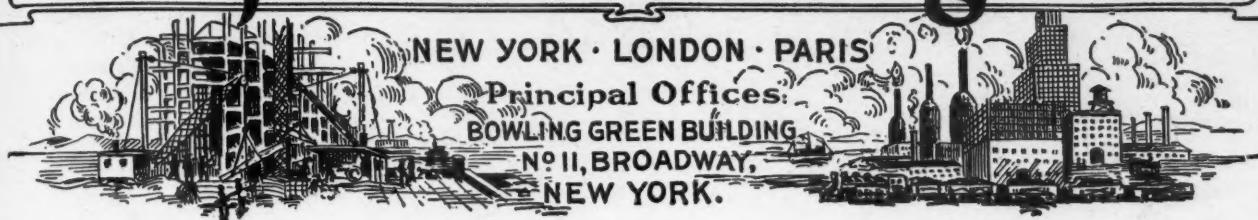
Louisville, Ky.
New York City
Norristown, Pa.
Pittsburg, Kan.

Pittsburgh, Pa.
Pottsville, Pa.
St. Louis, Mo.

Salt Lake City, Utah
San Francisco, Cal.
Wilkesbarr, Pa.
Wilmington, Del.

As a matter of reciprocal business courtesy help trace results

Compressed Air Magazine



VOL. XXVII, NO. VI

Copyright, MCMXXII,
Compressed Air Magazine Co.

JUNE, 1922

Compressed Air Applied to the Foundry

At the Present Time Labor-Saving and Economic Appliances Using this Medium in Great Variety Have Been Placed at the Disposal of the Modern Foundryman

By RICHARD HOADLEY TINGLEY

CASTING OR founding of metals antedates written history. Evidence exists that castings were made by the Egyptians 2,000 years before Christ, and early Jewish history tells us that Goliath of Gath used a helmet of brass and a target between his shoulders when he went into battle. One of the most conspicuous examples of the proficiency of the ancients in bronze casting is found in the description of the pillars of Solomon's Temple, cast by Hiram of Tyre, computed to have been 27 feet in length and nearly six feet in diameter, the thickness of the metal being "a hand's breadth."

Ancient and medieval records show that the casting of metals belonged to the realm of fine, rather than the industrial arts. The practice was confined to the molding of statues, effigies, ornaments and bells some of the latter being of prodigious size. The manner in which many of these operations were carried on is not made clear and it may be that the "lost wax" process was employed extensively, particularly in casting the smaller figures or ornaments.

Since the days of Tubalcain, the founder's art was a manual one. The age of machinery arrived and revolutionized all industry, but its effect upon founding perhaps was felt less than upon any other. Steam and electricity worked wonders in an infinite variety of operations formerly performed by hand. Not until compressed air was applied in the foundry can it be said that the foundryman had been emancipated from hand working in a degree at all comparable with other industries.

The use and application of compressed air antedate the Christian Era. It is recorded that Ctesibius of Alexandria invented a tube through which an arrow was propelled by compressed air and that Heron, also of Alexandria, was familiar with the production and uses of air under compression, and the influence of its qualities of expansion and contraction, applying them to the opening and closing of doors. It also is maintained by some authorities, that, the reduction of metals from their ores and forging of iron and steel brought the forge

DIFFERENCES of opinion exist with respect to the proper application of compressed air to the great variety of foundry work, but there is no controversy or difference of opinion over the broad question of the usefulness and efficiency of air in the foundry. Practically all foundrymen who have installed air in their shops agree that it is an absolute necessity if they would compete with their neighbors who have so equipped themselves.

Mr. Tingley has reviewed the various economic uses of air as applied to the foundry and the types of machines and appliances that modern engineering has placed at its disposal. The main point he aims to emphasize is that air now has become indispensable in the foundry as a dividend earner and foundry owners should remember that the longer they defer the installation of compressed air equipment in their shops, the longer they will labor under a handicap.

and the blast furnace, with the use of air under pressure, into existence as mechanical appliances before the year 2000 B. C.

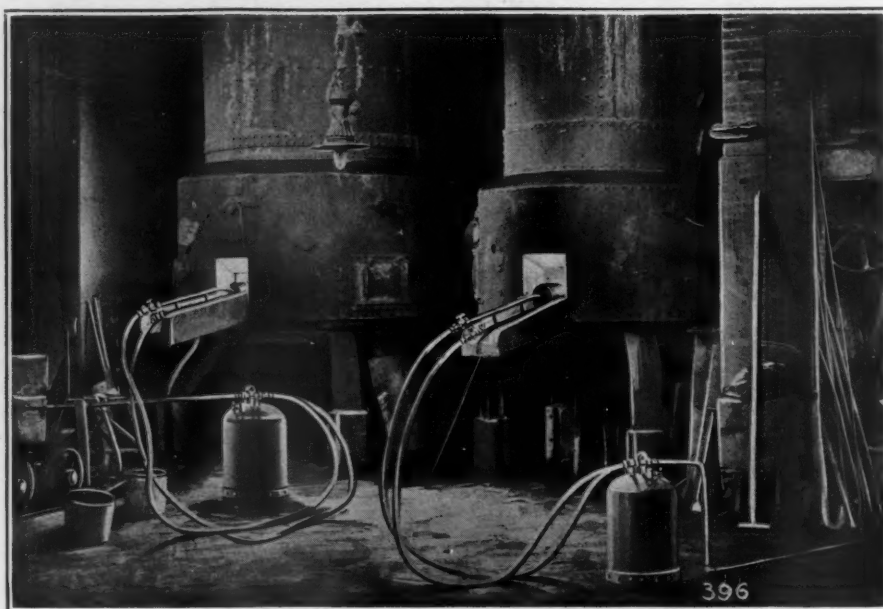
Foundry practice has undergone a marvelous development during the past generation, and it may truthfully be said that the introduction and application of compressed air to the many operations formerly performed by hand or crudely accomplished by power moving agencies of other sorts, have been the chief contributing agency.

As recently as ten or a dozen years ago, foundrymen who had equipped their shops with air found its uses restricted largely to the operation of pneumatic tools. The modern sand blast, the jolting machine, the hand rammer, the vibrator, the air lift, the air operated roll-over molding machine, the squeezer, the air-gun, the oil burners, the application of air to starting cupola fires, to spraying molds, to casting cleaning and chipping, to the operation of cranes, trucks and industrial cars, then were unknown or were so new that their usefulness was not well understood. Keen competition of foreign shops largely is responsible for the invention and application of these modern labor-saving foundry devices. To meet the lower wage schedules of Europe it was necessary to resort to every possible mechanical device and the manufacturers of compressed air appliances kept pace with the demand.

The dozen years of foundry development have fully demonstrated that air-driven machines practically have driven other power-movers from the field in many basic operations. Due to the constantly increasing use of these appliances the operating costs of foundries have declined consistently. The progressive foundryman finds it well worth while, if he would successfully compete with his neighbor, to provide himself with air and to practice all the economies made possible thereby.

To the question: Suppose your shop suddenly and permanently was deprived of air, how would your operations be affected? Many foundrymen replied with a shrug of the shoulders and the statement—we had better go out of business altogether—and further that production costs would be increased on an average of 40 to 50 per cent., and in certain operations upon which air is the main reliance, 75 to 100 per cent. General use of air in foundries is of such comparatively recent origin that many small shops, and some large ones still are without it.

There are 6,812 separate foundries in the United States which are engaged in turning out castings of gray iron, malleable iron and steel; 1,316 foundries cast brass, bronze and copper;



Courtesy, Hauck Mfg. Co.

Starting fires in the cupola. An example of an air-blown oil burner installation in operation lighting fires through breast holes. The use of oil burners enables the quick starting of fires under any weather conditions, eliminating the annoyance and delay that so frequently occurs, due to poor drafts, winds from the wrong direction, damp fuel and other causes.

2,363 cast aluminum and a variety of alloys, aggregating a yearly gross business of upwards of over one billion dollars in iron and steel, and non-ferrous foundries have a volume of over \$200,000,000 annually in normal times. This article will touch briefly upon the many machines and appliances in which the use of air makes it possible for foundrymen to turn some considerable portion of this gross business into profit.

The foundryman will find that he has uses for air at pressures anywhere from a few ounces up to 100 pounds.

Air under low pressure is employed as a super-draft on malleable furnaces and as a direct draft on cupolas. Air also is used in the Tropenas, or side-blow converter, a modification of the Bessemer type, in which air is

blown on the surface rather than through the metal. In the usual practice of operating the Bessemer converter an air pressure of some 25 pounds commonly is employed, while in the Tropenas process, the pressure supplied by a rotary pressure blower is reduced to about three pounds.

The oil-air torch is employed in starting the furnace fires, and serves, also, to raise the temperature of the ladles so that they will not chill the charge when the molten metal is poured into them. This appliance has become a standard part of foundry equipment, and is extensively employed in drying the molds. The burners atomize the oil, giving a soft yellow flame which dries the sand to a depth varying with the length of time the flame is applied. In average practice it is found that the sand will

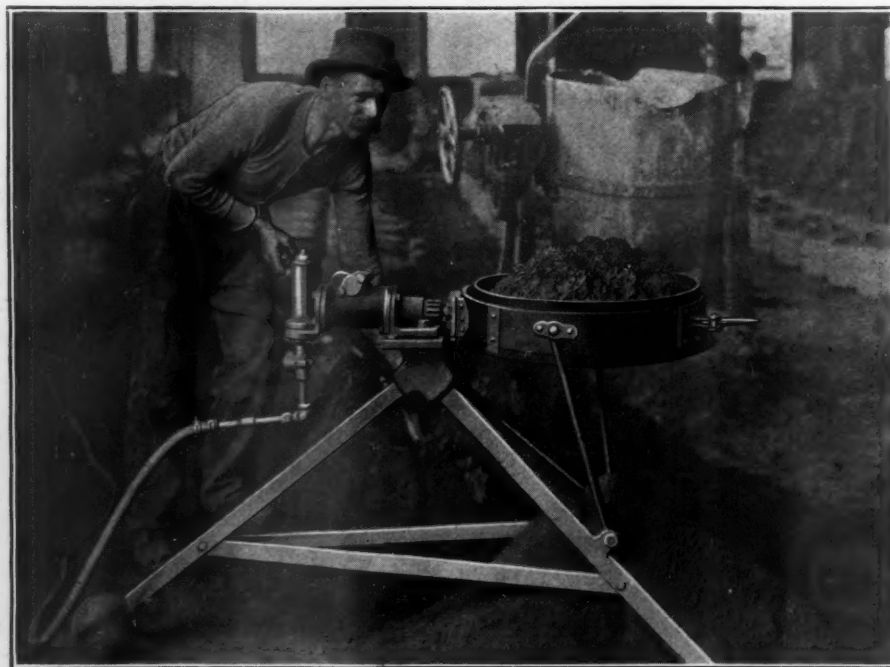
dry to $\frac{1}{2}$ -inch depth in five minutes, sufficient for castings having a thickness of one inch or less.

More than a century ago devices were invented for the relief of the molder, mechanically, in the most difficult operations he is called upon to perform. Aside from ramming the mold, drawing the pattern probably is the most difficult of his duties. If this operation is not performed accurately, the mold practically is ruined.

In a paper tracing the evolution of modern molding practice presented before the American Foundrymen's Association by J. J. Wilson and A. V. Backert some time ago, it was stated that, among the earlier patents are those covering the use of hydraulic cylinders, rollers and other devices intended to pack the sand mechanically. This step also was taken for the purpose of eliminating the lack of uniformity in the density of the sand of the various molds rammed by hand by the same man. The ramming of sand by the jarring principle was written into the patent records more than 45 years ago, but owing to the difficulties involved in packing the sand this principle was allowed to lie dormant for nearly 20 years when compressed air came to the front and was applied as the power for operating these machines. In the meantime various processes were tried out to eliminate hand ramming. Among these was the use of a water-bag intended to pack the sand by gravity due to the weight of the water which compressed the sand to its greatest density at a point farthest from the pattern instead of in the opposite manner. Compressed air also is utilized for this purpose and the vacuum principle was applied for drawing the pattern. The latter had a limited vogue owing to the difficulty involved in creating the vacuum when the parting surfaces of the patterns became roughened. However, the jarring principle had demonstrated its value and usefulness in ramming sand and compressed air had solved its practical application where other agencies failed.

The various processes incident to molding castings now consume more air than any other single or series of operations. In answer to the question, "Of all the devices operated by compressed air, which do you consider the most useful and economical?" Foundrymen, almost without exception have replied: "The jarring machine." The manufacturers of air operated machines claim that the cushioned blow of this type of machine promotes an even density of the sand than that produced by electrically driven machines, or in any other manner.

The modern jarring or jolt machine is equipped underneath with an air cylinder and piston attached directly to a table on which is placed the flask full of sand. By a suitable valve, air is admitted under the piston, raising the table to a distance pre-determined depending upon the size of the mold. At this point, the air automatically is released and the piston and table with the mold drop with a bang, thus uniformly settling and ramming the sand about the pattern. After a sufficient amount of jolting has been done, the top surface of the sand is

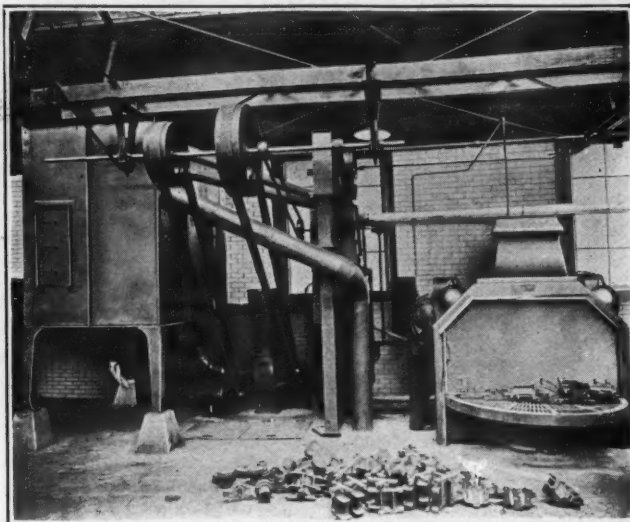


Sand sifting machine.

Courtesy, Hanna Engr. Works.



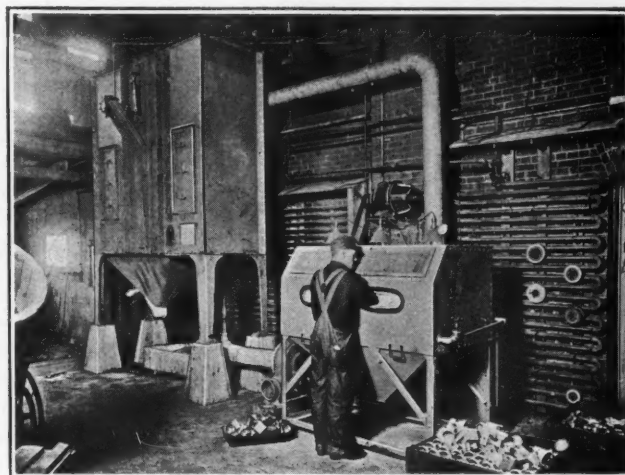
Home made installation showing hose machine and abrasive separator. In this type of installation, the abrasive is shoveled from floor to separator, the clean abrasive being placed in hose machine. The machine has direct pressure thereby realizing the maximum efficiency from the air.



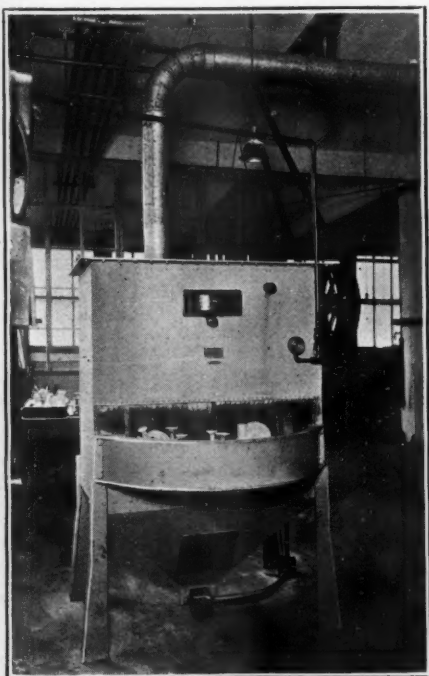
Hygienic cabinet sand blast with cloth screen dust arrester alongside, the operator being on the outside. The table is loaded by common labor and turned to bring it inside the cabinet for blasting.



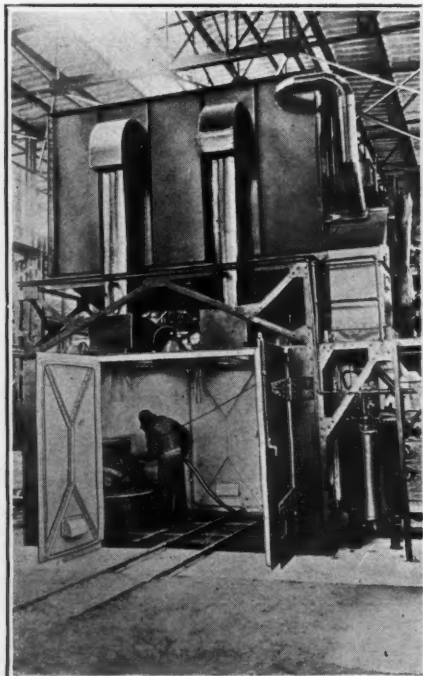
Battery of barrels with gravity feed.



Cabinet with cloth screen dust arrester.



Rotary table with self-contained continuous suction feed.



A room installation with cloth screen arrester. The table loaded from outside. This type permits automatic separation and reclamation of abrasive.



Gravity feed automatic table sand-blast. Cloth screen dust arrester alongside.

Photos, Courtesy Pangborn Corporation.

further rammed by a pneumatic rammer. Supplementary devices, also operated by air on some machines are employed to roll the mold over and draw the pattern.

Another type of air operated machine at the disposal of the modern foundryman is the power squeezer, an adaptation of the hand squeezer. This type of machine is specially adapted for light work in large quantity. It exerts a squeezing pressure, rather than a jolting action and may be adjusted to different depths of flasks.

A most important adjunct to molding machines is the vibrator. The vibratory motion is induced pneumatically after the sand has been rammed about the pattern, and is intended to shake the pattern free from the adjacent sand so it may be lifted or withdrawn without marring the impression in the sand. Many designs of air operated vibrators are in use, materially reducing the molding time and increasing the number of molds which may be made each day. For this purpose compressed air has been found to be preëminently well fitted to play the part of the energizing medium, because air has a distinctive cushioning effect and yet is positive and vigorous in its action.

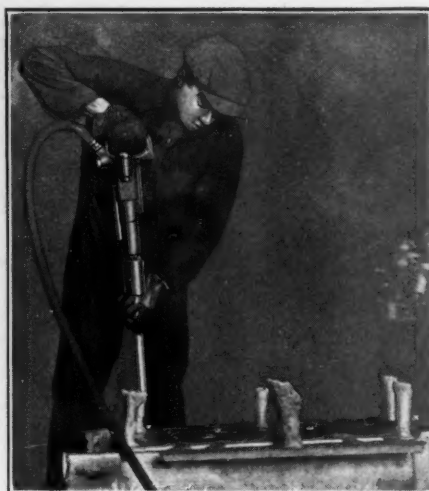
Owing to the extremely small quantity of air consumed in their operation, pneumatic sand rammers, pneumatic chippers, scaling hammers, brushes and grinders are indispensable when economy is sought. Almost the first in importance is the sand rammer. These efficient tools are built for ramming heavy molds on the floor, or lighter ones on the bench. Their size is graduated to the duty they are expected to perform. It has been claimed by foundrymen of experience that it would be economy to install a compressor plant, if one did not already exist, for use in operating pneumatic tools alone.

Careful experiments in the savings made possible by the use of pneumatic sand rammers over hand ramming show that a reduction in time by the former over the latter is as five to one and in one instance has been 6.6 to one. These are not test figures, but results obtained from everyday operations under average conditions. The pneumatic sand rammer has demonstrated that it is one of the greatest labor savers in the modern foundry. When the sand rammer first was introduced, some criticism was experienced arising from the natural antipathy molders had for anything in the machine line, but as operators became familiar with its use, this feeling disappeared. Today in the foundry, the men take kindly to these rammers, and use them for work of every description.

Pneumatic chipping hammers find their most



Pneumatic sand rammers working on a large mold.



Core breaker jarring out cores from aluminum automobile crank cases at plant of General Aluminum & Brass Mfg. Co., Detroit, Mich.

efficient use in removing the gates and risers of castings, and for nicking them preparatory to sledging. They also are used for removing the inequalities or uneven projections on the casting, for chipping fins, and for general trimming of any irregularities on the surface. As an economic tool their usefulness is hardly surpassed by the sand rammer. In ordinary practice, one man with a chipping hammer of the proper size, will do as much work as three or four men chipping by hand.

The air hoist is specially adapted to foundry work because of its delicacy and elasticity of action. Flasks, molds and ladles charged with their molten contents must be handled with care and lifted with a positive, dependable, easily controlled motion. It is here that the air hoist finds its greatest application in the foundry for, without a jar, it will lift cokes and large patterns and place them accurately where needed. Air hoists also are useful in conveying flasks into and out of the foundry; patterns to the pattern shop or storage and castings to the machine shop, truck or railroad car.

The air hoist is so simple in its operation as



Courtesy, Hauck Mfg. Co.

Patching a core. The air-blown oil burner offers a practical method for patching cores and spraying seams. It is useful in the core room of foundries casting metals of all sorts.

to be almost fool proof. Loads may be lifted a dozen times while a gang of men using chain block or windlass would be raising the same weight once. With its assistance, it is possible to keep the foundry floor free from the obstruction of partly finished work, yet it seems strange that, of all the air appliances useful in the foundry, this aid to efficiency seems to be less appreciated than almost any other. Many foundrymen whose shops are equipped with all manner of air devices, and who would not part with its labor saving functions on any account, still cling to some old methods. Possibly they do not realize the cheapness and convenience of the air hoist.

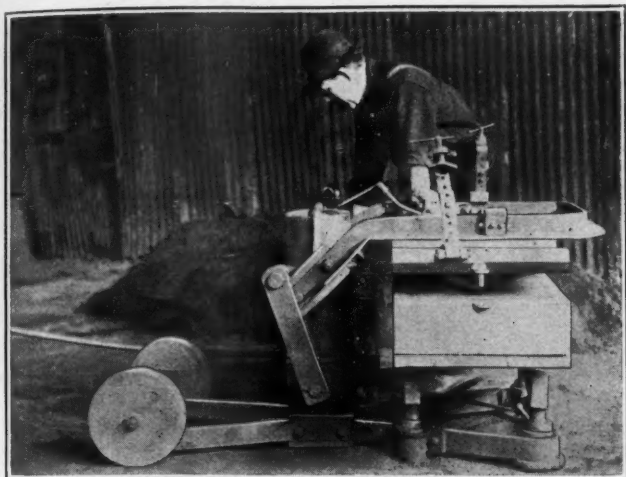
It has been estimated by Frank Richards, a well known authority on compressed air, that, at 100 pounds gage pressure, compressed air costs but five cents per 1000 cubic feet of free air. He shows that a hoist six inches in diameter with a piston rod one inch in diameter, and a lift of four feet, using air at 90 pounds pressure and figuring 30 per cent to cover all contingencies including the taking up of the slack of each hoisting chain or other means of attaching to the load before hoisting actually begins, will lift more than a ton to a height of four feet at a cost of \$0.00035. A hundred such hoistings, therefore, will cost but 3½ cents.

Discussing the particular advantage to foundrymen of the air hoist, W. H. Armstrong in a paper read before the New England Foundrymen's association gives the results of some of his observations as follows: "The load is perfectly controlled, both for hoisting and lowering, and may be started and stopped twelve times per inch of lift; the hoist absolutely will hold any load up to capacity at any point of the lift. . . . There is no vibration or jumping, and delicate molds can be handled with perfect safety."

The sand blast principle as applied to foundry work is by no means new and it would be difficult to conceive of a foundry of any considerable size operating without the aid of this economical process. Next to the uses of air in pouring and molding, sand blasting is the greatest dividend earner. The older methods of cleaning castings by hand, or by tumbling barrel were slow and expensive. Improved tumbling barrels are found to function with considerable efficiency in cleaning small



"Little David" chipper and grinder working on transformer casings at Westinghouse foundries, near Pittsburgh, Pa.



Courtesy Adams Co.

Pneumatic jolting and molding machine. Upon opening the air valve admitting the air slowly to the piston, the pattern will be slowly and smoothly drawn, while the air rapper will vibrate the pattern.



Courtesy Adams Co.

Jolt ramming the mold. Solid wheels resting on planks embedded in floor serve as anvils. Many molds need no additional ramming but in deep molds the friction of sand between the flask and pattern may leave it soft and additional ramming with a pneumatic sand rammer may be necessary.

castings and, while it is true, that some of the older methods, such as brushing, tumbling, pickling and blowing still have their advantages for particular classes of work, the real solution for general commercial work, including all classes of castings, large, medium and small, is found to be in the sand blast room.

Many makes, styles and kinds of sand blast apparatus are available, each having its own peculiar advantages. Some are designed to employ high, and others, low air pressure. Indeed the most efficient and economic pressure to apply to the sand blast room still is an open question. Many advocate and use air at 30 pounds, while others favor a pressure as high as 90 pounds.

The sand blast room itself is necessary, mainly, to localize the dust arising in the sand blasting process; also to retain sand particles which due to the force of the blow upon the casting, will rebound. Furthermore, sand is expensive and can, if retained, be used over and over again, thus, to return the sand to the sand blast machine without additional labor to the operator, means are employed to collect the used sand for future use.

Sand blast machines are divided into four

general groups: hose machines, cabinets, barrels, and tables. The method of operation may be either the direct pressure, the suction (syphon) or the gravity system.

D. H. Gates, Pangborn Corp., Hagerstown, Md., believes that the direct pressure system perhaps, is the most popular for, by this method, the sand is under pressure in a sealed container. Sand and air are discharged in combination, without expansion, through a hose nozzle giving the greatest velocity and highest possible efficiency. The majority of hose machines are of the direct-pressure type; indeed, the first application of sand blasting was the hose machine type and it is still used almost without exception in sand room installations. It offers a range of application difficult of attainment by any other type. Where the tonnage is large and the castings are of weight and size too great for convenient handling, it is indispensable. The use of the hose machine demands an enclosure, and experience has shown the wisdom and economy of a well ventilated and well lighted room for the purpose.

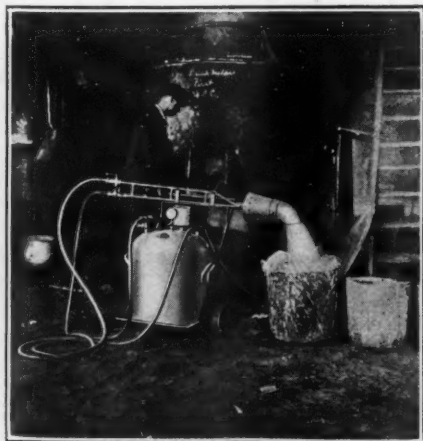
The heart of the sand blast equipment is the sand blast tank, and, like the heart of the human machine, must be absolutely dependable. The lungs of the system are of course the air compressor.

The Industrial Air Engineering Co., Elyria, O., recently has placed a new adaptation of the air blast tank on the market which is worthy

of more than passing notice as it is, apparently, an improvement over older designs in some respects in that a single valve controls the operation of the tank.

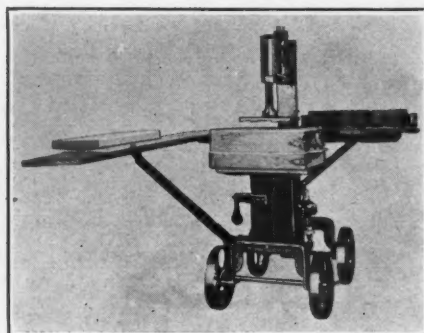
The compressed air enters a pressure-equalizing chamber and moisture trap in the lower portion of the tank. Oil and water vapor condensing in the pipe line leading to the tank from the compressor are separated from the air current and collected on herringbone surfaced baffle plates. The moisture drains toward the side walls and accumulates in the bottom where it may be drained off through a small opening provided for that purpose. When the plug is removed from the drain hole, the air pressure drives the accumulated drippings through the hole. The chamber also serves as a cushion to neutralize the pulsation of the compressor.

To insure a constant and uniform flow of sand through the mixing chamber, it is essential that the pressure above the sand in the tank and below the tank in the mixing chamber should be maintained at a common level. The equalizing chamber serves this purpose by maintaining a pressure above the sand through a pipe on the inside of the tank and below the sand in the



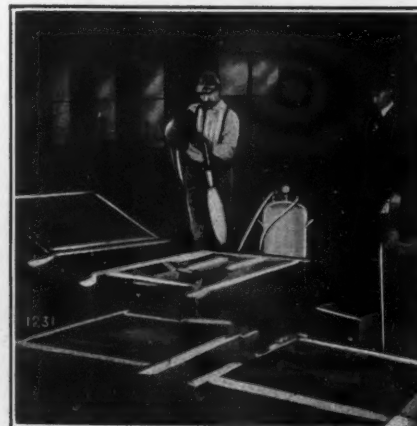
Courtesy, Hauck Mfg. Co.

Method of drying and heating ladles and crucibles in a gray iron foundry using an oil burner with an elbow nozzle.



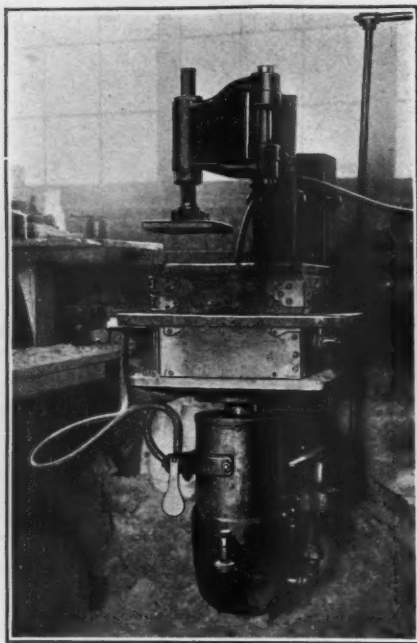
Courtesy Federal Malleable Co.

Portable squeezer designed for working on the left of the sand pile and combines speed with the advantages of being portable.



Courtesy, Hauck Mfg. Co.

Drying molds. The air-driven oil burner will dry the sand in the six molds shown in the illustration to a depth of a half inch by the use of two gallons of oil and at a cost of about twelve cents.



Courtesy Federal Malleable Co.

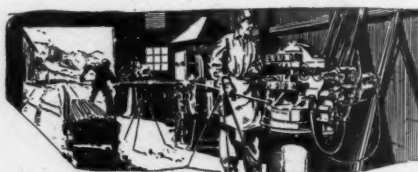
Rapid jolt squeezer, mounted on an 80-pound railroad rail. Heavy castings are used throughout to withstand the shock of the jolt. Both jolting and squeezing pistons are fitted with piston rings to eliminate air leakage.

mixing chamber, through a pipe leading directly into the equalizing chamber. The various areas of the pipes and chambers are proportioned so that the compressed air when entering the equalizing chamber first passes through the air line on the inside of the machine and into the sand filling valve. The air line terminates in a stationary hollow piston operating in a cylinder which serves as a sand filling valve.

When the air is turned on, the sand valve is pressed tightly against a rubber gasket and thus seals the tank. The space above the sand in the tank then is filled with air under pressure through the branch pipe which extends above the sand level. With an equal air pressure above and below, the sand will flow by gravity into the sand-mixing chamber through the valve provided in the bottom head for that purpose. When the air is shut off, the sand-filling valve will fall by gravity and admit a fresh supply of sand. The further flow of the remaining sand in the tank is checked by the baffle plate in the mixing chamber.

New uses and applications of air as a valuable aid to the foundryman are being discovered and put into practice constantly. Space does not permit a description of all of these, although mention, in passing, should be made of the many types of sand separators, sand sifters, air separators, sand dryers, dust arresters, ventilating equipments, pneumatic vibrators, air cleaners, blow guns, sprayers, etc.

If space permitted operating costs in tabulated form might be presented, showing the economies obtained from the use of the main devices covered in this article. At the risk, however, of telling the foundryman many things he knew before, it has been the intent of the writer to impress the fact that a foundry not equipped with compressed air labors under a handicap, compared with foundries which have adopted it.



DRILL STEEL—BITS AND SHANKS

[Drill steel has always been a much discussed subject and it probably will continue to be as long as there is rock to drill and blast. We are continually receiving letters asking for advice on various phases of this subject. Most of these questions and their answers are of interest to a large part of our readers, and therefore this column is published in order to give our readers the benefit of the service that we have been rendering through this correspondence. Questions are especially invited which have to do with any phase of forging, tempering and the care of drill bits and shanks. Our answers, based on the best modern practice, will be published in succeeding issues.—Ed.]

Compressed Air Magazine,
New York City.

Dear Sirs:—I have been hearing a lot about the double taper 14° and 5° four-point cross bits. Will you kindly tell me what is the advantage, if any, of this double taper over the straight 14° bit.

Syracuse, N. Y.

E. F.

The double taper 14° and 5°, four-point cross bit is found particularly advantageous where the rock is very hard or broken. It will drill a round hole under adverse conditions. The 5° portion, when made in the gaging blocks having a Carr curve, forms a large wearing surface so that the gage will wear much longer. Variation in gage between successive bits generally can be reduced by half so that if the bit of the starter in a 6-ft. set, 12-in. run, of "Jack-hammer" steels is 1-7/8 in. diam., and the diameter of the bit of each succeeding steel varies by 1/8 in., making the last diameter 1 1/4 in., this usually can be changed so that the bit diameter of the starter is 1-9/16 in., each succeeding bit varying by 1/16 in. and still having the last steel 1 1/4 in. in diameter.

Compressed Air Magazine,
New York City.

Dear Sirs:—We have had several discussions since starting work in this quarry about the proper way to form the cutting edge of a four or six-point bit. Many quarry blacksmiths round the points instead of bringing them out straight to a point making the steel like a cluster of round point chisels instead of square point. In comparison with square points what effect has this practice on cutting speed. We would like you to settle this matter.

Rutland, Vt.

Yours truly,
H. S. T.

The corner should be brought out full and sharp and this will greatly increase the cutting speed and permit of free rotation of the bit in the hole.

Compressed Air Magazine,
New York City.

Dear Sirs:—Will you please tell me what are

the effects of working the steel when it is too hot and also working it when too cold when forming the bits. We seem to always have the steel either too hot or too cold, as we don't get the right kind of steel on this job.

Buffalo, N. Y.

R. McL.

If the steel is worked too hot, excessive breakage frequently results, and neither bits nor shanks will stand up due to burning the carbon. If steel is worked too cold, it is difficult to fill out the corners. Also, the metal cannot be worked freely and folds are likely to occur. Furthermore, when working cold steel in a sharpener, dolly breakage is not an infrequent result.

* * *

Compressed Air Magazine,
New York City.

Dear Sirs:—I am working at rock drilling underground and I would like to know what trouble will be made by a smaller size of the hole in the steel where it passes through the lugs. Also please tell me what effect this smallness would have at the bit end.

Yours truly,

M. P.

Joplin, Mo.

A hole should always be open to the full size if the best results are to be obtained. Any restrictions under the lug or collar prevents the full amount of water and air passing to the cutting edge. At the bit end of hollow steel the hole should be open in good shape for the same reason as given above, as it is very important to prevent plugging of hole by soft or sticky ground. Also excessive fogging is liable to occur, which is usually objectionable in mines having high temperatures.

* * *

Compressed Air Magazine,
New York City.

Dear Sirs:—Kindly let me know what trouble can be caused by having fins on the points of cross bits. We have had fins form on our bits for some time and I would like to know what effect they may be having on our drilling.

Yours very truly,

G. R. C.

Platteville, Wis.

The main objection is that when the bit is inserted in the hole the fin will break off and is liable to carry with it a certain portion of the cutting edge or corner which would impair the drilling speed of the bit. If bits are not made to accurate size they will not follow in the hole.

EFFECT OF BACK PRESSURE ON OIL PRODUCTION

In the study of the effect of regulated back pressure on oil production, the Bureau of Mines has found that wells being produced under several pounds back pressure are not declining as rapidly as other wells in the field. This investigation is of especial interest, as if it can be demonstrated that pressures up to ten to fifteen pounds can be carried on the wells without affecting the production, it will result in saving large quantities of gas, now wasted, by producing the wells at atmospheric pressure.

The Compressor For Foundry Purposes

Lubricating System, Method of Regulation, Air Receiver and Aftercooler Have Much Influence Upon Operation of Pneumatic Devices

THERE IS no industry that has profited more by the substitution of compressed air for hand methods than the foundry. The volume of compressed air used, and also the fact that so many foundries are now dependent upon this supply of air for maintaining operations, emphasize the importance of the proper selection of the heart of the system—the air compressor.

Practically all compressors of modern design are built to reduce necessary attendance to a minimum. The most important advance recorded in accomplishing this purpose was the adoption of the enclosed flood system of lubrication, first used on "Imperial" compressors about twenty years ago. This system, with slight modifications, is now used on practically all modern machines because it is the most automatic, reliable and economical method of lubricating the main bearings, crosshead and crank pins, and crosshead guides.

The crank case of the compressor is in this system entirely enclosed, thereby preventing the entrance of dust or dirt that would interfere with the lubricating quality of the oil and cause injury to the bearings. Furthermore, this feature also prevents the escape of quantities of oil upon the floor and foundation or around parts of the machine itself which is a constant annoyance. The present practice is to use force-feed lubricators for oiling the air cylinders. The use of automatic plate air valves has reduced to a minimum the need of outside valve gear for operating the valves and this has also reduced the attendance necessary.

Compressors are now being built for practically any type of drive and the type selected will depend upon the local conditions affecting the cost of power. The three most popular types of drive in the foundry are: belted to line shaft or motor; direct-connected electric motor-driven; or compressors having the air cylinders connected in tandem to a steam engine. The illustrations of these various types show clearly the general details of construction and arrangement.

A most important feature of any air compressor for foundry use is the regulation of the air output. For small single-stage belt driven units an intake unloader is used. With this type of unloader the intake is automatically closed when air pressure is built up in the air receiver and the compressor runs unloaded. When the air is drawn from this receiver the pressure drops and, at a certain predetermined point, the intake unloader is opened automatically and the compressor again assumes its load. In some cases a discharge line unloader is furnished, which opens the compressor discharge to atmosphere during the unloaded period, and permits the escape of any air which might leak by the intake unloader. This unloader is operated automatically in conjunction with the intake unloader.

Where larger duplex machines are used the question of operation at partial loads assumes greater importance. In the foundry the amount of air required to operate the tools varies with the number in use. Sometimes the whole capacity of the compressor will be utilized and this will be followed by a period when only half the capacity, or less, will be required. To take care of these changes in capacity requirements, compressors are equipped with unloaders which permit of efficient operation at partial loads.

The Clearance Control is probably the best known method of regulating belt driven compressors and direct-connected electric motor-driven compressors of medium and large capacities. Owing to the fact that variable speed motors are expensive and complex, practically all compressors of these types are driven by constant speed motors. Therefore, a reliable and efficient method of regulating the air output with the compressor operating at constant speed is necessary and this regulation must be secured without causing sudden surges in the electric service lines.

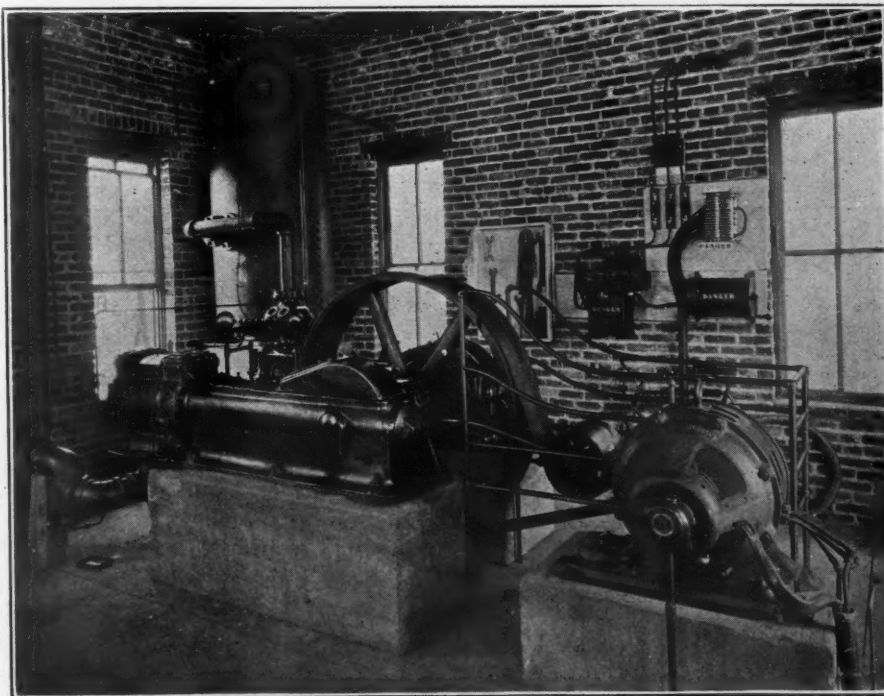
With the Clearance Control a number of clearance pockets are made integral parts of the cylinder, and the regulation is obtained by the control of the volume of air compressed during the period that the air is in the cylinder. The pockets are automatically thrown into communication with the ends of each air cylinder in proper succession, the process being controlled by a predetermined variation of the pressure in the air receiver. The operation is as follows: With the compressor operating at partial capacity a portion of the air is compressed into an

added clearance space instead of passing through the discharge valves. On the return stroke this air expands giving up its stored energy to the pistons. The inlet valves remain closed until cylinder pressure equals the intake pressure at which time they open automatically and free air is admitted to the cylinder for the remainder of the return stroke. With this method of unloading a constant ratio of compression is maintained throughout the entire range and the reduction in power secured is practically in direct proportion to the reduction of load.

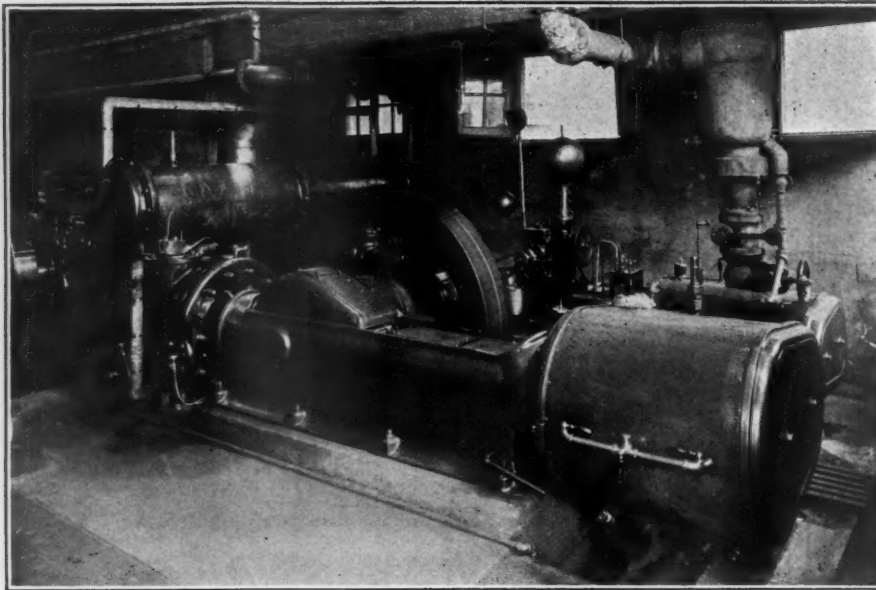
The Clearance Control is entirely automatic in operation. The method of unloading and loading the compressor by steps prevents any undue electric current fluctuation and reduces the strain on the motor and compressor which might be caused by sudden changes in load. The operation is such as to cause the compressor to operate at full, three-quarter, one-half, one quarter or no load, depending upon the amount of air which is used in the foundry.

Steam Driven Types

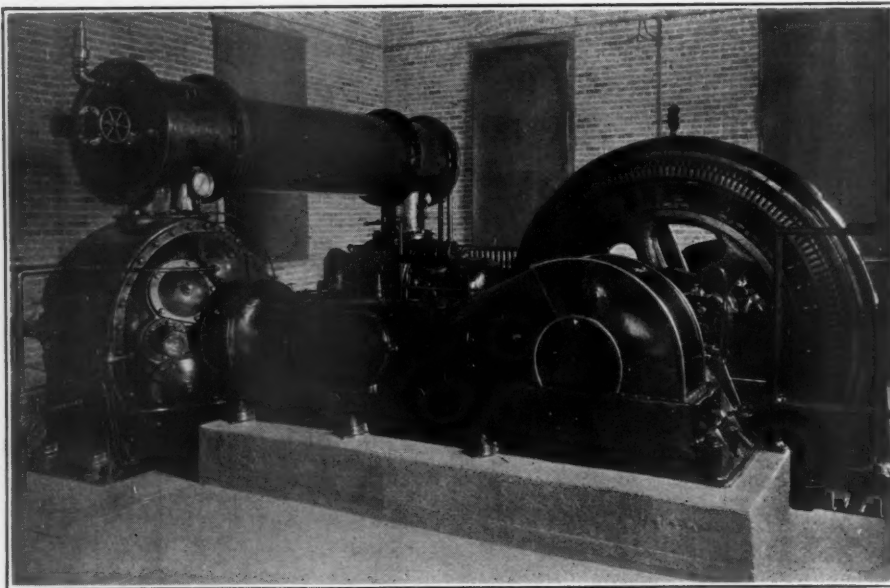
There are a large number of steam driven machines which are equipped with flat steam or Meyer Type valves and throttling governor. However, the inherent economy of high steam pressures and superheat has been recognized by compressor builders who have designed steam valve gears which will operate satisfactorily at the high steam temperatures and pressures. A noteworthy example of this type of machine where telescopic steam valves are used is shown in the illustration at top of 160. The cutoff valves which telescope inside the main steam valves can be converged or diverged and



Two-stage compressor using short belt drive.



A very popular type of steam driven compressor having piston steam valve gear permitting the use of high steam pressures and superheat.



Large foundries are using direct-connected motor-driven compressors provided with Clearance Control for regulating the output.



A very excellent arrangement of air receivers located outside the compressor house.

in this manner change the point of steam cutoff.

The regulation of this type of compressor is accomplished by an oil governor of the speed and pressure type. This governor maintains a constant air pressure regardless of the air demand. It regulates automatically the cutoff of the high steam pressure to take care of variations in admission steam pressure or exhaust pressure. The governor also adjusts the speed of the compressor to the demand for air and prevents the compressor from exceeding a maximum safe speed. All three operations are taken care of automatically by controlling the cutoff in the high pressure steam cylinder. In a machine of this type the steam consumption per cubic foot of air actually delivered is approximately constant for full, three-quarter and one-half loads and for points under one-half the rate of increase is very small.

The Air Receiver

Every air compressor should discharge its air into a receiver. The purpose of the receiver is not for storage of air but to reduce the pulsations caused by the air discharge and deliver a steady flow to the pipe line.

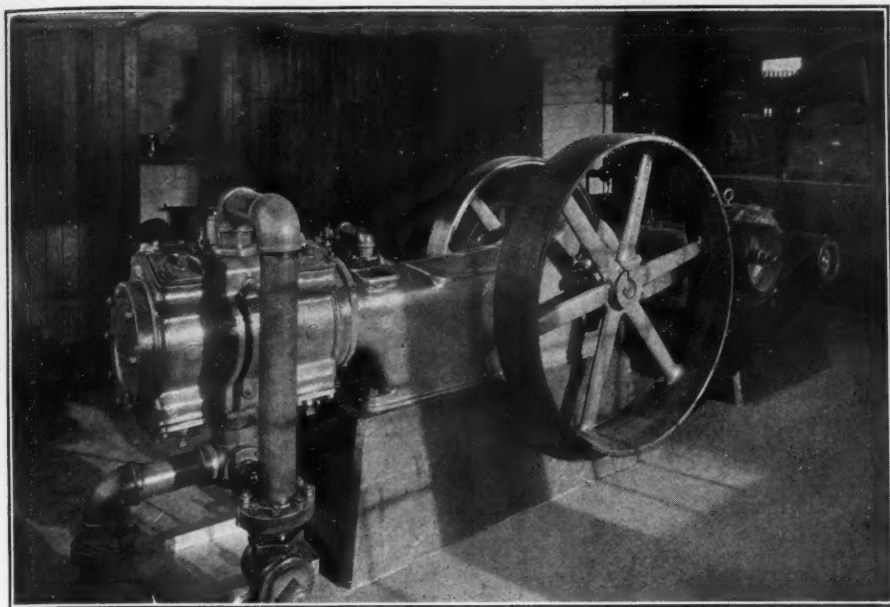
There is some cooling of the air in the receiver and for this reason it is sometimes considered advisable to place the receiver out of doors. However, it should be borne in mind that the receiver should be located as close to the compressor as possible, and that the intake should be piped at the top of the receiver and the discharge at the bottom. In this way any moisture which is condensed from the air will drop to the bottom of the receiver where it can be drained. All receivers should be equipped with a pressure gage, safety valve and drain cocks.

Aftercooler

Where air is to be used in pneumatic tools, vibrating machines, jarring machines, and for sand blast it is essential that moisture be avoided as much as possible. Moisture in the air destroys the lubrication of reciprocating machines causing excessive wear which will eventually result in inefficient operation and air leakage. Furthermore, moisture which is condensed in the pipe lines causes "water hammer" which results in leaky joints and often retards the passage of air causing loss of power. In foundries this is particularly serious because the pipes may freeze and rust. Of course, moist air is equally bad for sand blast work.

An effective method for securing dry air is to install an aftercooler into which the air is discharged from the compressors and through which it must pass before it enters the distributing system. Of course, the cooling accomplished in an intercooler of a compound compressor will take a great deal of moisture out of the air. However, in the high pressure cylinders the air is again compressed and unless this is cooled before entering the pipe lines moisture will result.

Many foundries have discovered that before the installation of an aftercooler was made the operation of their tools was sluggish because the water in the air washed the lubricant away. Later, when aftercoolers were installed, the same tools had much more power, were more



Small single-stage belt-driven compressor.

snappy in action, and their life was much longer.

Aftercoolers are of very simple design and not expensive. In general they are similar to the intercoolers which are placed between the high and low pressure cylinders of compound compressors.

L. H. G.

SCIENCE AND SUPERSTITION

By P. B. McDONALD

Assistant Professor of English, College of Engineering, New York University

SCIENTISTS ARE fighting constantly against superstition. They are having to persuade tax-payers that typhoid epidemics are a consequence not of inevitable fate but of impure water, that run-down farms or barren lands can be reclaimed by rational application of fertilizers or irrigation, and that a platitudinous lawyer cannot serve on technical commissions so well as a clear-headed engineer. People in the mass change old prejudices and superstitions very slowly. The voters and tax-payers of today are direct descendants of the witch-burners and theological bigots of yesterday. Superstition and ignorance are as old as the human race, and mob psychology has always afflicted civilization. Possibly, our present obsessions and stupidities will seem as absurd a century hence as outgrown customs now seem to us, though it is difficult to believe so now.

Scarcely half a dozen generations ago witchcraft was believed in implicitly. In the enlightened age of Shakespeare for instance—the so-called spacious days of Queen Elizabeth—the ancestors of our tax-payers of today blamed long winters or bad crops or disease on some harmless old woman who happened to act furtively or look askance. If a farmer found his cows giving less milk than formerly, or a child developed fits, or flies or caterpillars appeared in large numbers, some individual in the community who seemed of an unusual type would be accused of the black art with which he was bewitching things. Such a victim would

be tortured to be made to confess his guilt and the names of his accomplices, and under the spur of the ingenious burnings and pinchings of cruel officials would confess almost anything—naturally.

The number of witches and sorcerers punished in this way ran into the hundreds of thousands! One prominent jurist of the seventeenth century, Benedict Carpzov, was accustomed to boast of having read the Bible on witches and sorcerers. One of his victims was a Saxon physician who produced twenty mice by a sleight-of-hand in a public house. He was denounced as a sorcerer, tortured, and burnt, and his children were bled to death in a warm bath by the executioner, lest they acquire similar diabolical powers. (Charles Singer's *Studies in the History and Method of Science*). The witch-hunters based their cause on the scriptural injunction "Thou shalt not suffer a witch to live," which surely seemed definite enough.

The medical cures for disease in the Middle Ages included many queer ones. In some cases the remedy consisting in placing a dead fowl on the chest of the patient, or binding herbs to the feet, or smelling white mice. For anemia a medicine made from the bones of a tiger was given. A favorite nostrum was ground-up mummy from Egypt, and the demand for mummies by physicians became so great that faked mummies were manufactured and sold as genuine.

So intent were people of the Middle Ages on thoughts of the other life to come that religious reasons were advanced to explain natural phenomena. The dark spots or shadings on the moon were laid to be reminders of Adam's sin, "blots on the escutcheon" put there by God as a warning to sinners. J. L. E. Dreyer says, in his book "*Tycho Brahe*," speaking of the sixteenth century, after Copernicus had published his heliocentric theory to the world, that the common belief about comets explained that they "were formed by the ascending from the earth of human sins and

wickedness, formed into a kind of gas, and ignited by the anger of God. This poisonous stuff falls down again on people's heads, and causes all kinds of mischief, such as pestilence, sudden death, bad weather, etc." Besides comets, other causes of disease were thought to be demons, storms, eclipses, earthquakes, volcanic eruptions, the flight of birds, the appearance of insects, etc.

When Galileo argued for the Copernican theory, his colleagues on the faculty of the University of Padua ridiculed it, and refused to look through the telescope that he had invented. One professor argued thus: "There are seven windows given to animals in the domicile of the head, through which the air is admitted to the tabernacle of the body, to enlighten, to warm, and to nourish it. What are these parts of the microcosmos? Two nostrils, two eyes, two ears, and a mouth. So in the heavens, as in a macrocosmos, there are two favorable stars, two unpropitious, two luminaries, and Mercury undecided and indifferent. From this and many other similarities in nature, such as the seven metals, etc., which it were tedious to enumerate, we gather that the number of planets is necessarily seven. Besides, the Jews and other ancient nations, as well as modern Europeans, have adopted the division of the week into seven days, and have named them after the seven planets. Now if we increase the number of the planets, this whole and beautiful system falls to the ground."

Another of these philosophers argued that animals which move have their limbs and joints; the earth has no limbs and joints, therefore it cannot move. A century and a quarter earlier, when Columbus declared that the earth is round, some of the renowned philosophers of Spain replied that, if it is, how could a ship sail back to Europe since it would be sailing uphill on the globe.

The great Italian poet Dante, in his "Divine Comedy," summarizes a common theory of the thirteenth century as to the nature of the earth. According to that view, it would be possible, suitably guided, to descend into Hell on a tour of inspection, by walking down a volcano on an island north of Sicily. Hell, it was believed, was composed of graded circles beginning just below the earth's crust and converging in an apex at the center of the earth. Dante, in the trip which he describes, saw all the horrors of Hell—sinners suffering from fire, snakes, freezing, desolation, etc.—and then passed through a narrow vent to Purgatory, an island in the great ocean that too, covered the other side of the earth. Souls had to be purged in Purgatory before being fit for Paradise, and both places are graphically described in this book, which is of course one of the great literary achievements of all times.

These extreme beliefs and literal interpretations appear naive in the light of modern science, for they were held in a period when little was known of the physical universe. They show the possibilities of the human mind, and, by the laws of heredity, to what divagations and incredulities the race of men is liable. In spite of the tremendous strides in enlightenment that the modern world has made, the man who walks

by a skyscraper and gets into a motor-car, is a lineal descendant of the man who, a few centuries ago, believed that disease could be spread by the look of an affected person (since particles were thought to proceed from the eye to the person looked at); who ate the flesh of a spotted snake to cure a spotted fever; and who objected to lightning rods because they would interfere with Divine vengeance for the killing of sinners. Experience and knowledge have come to our age, but we still retain the faculty of making blunders and forming ludicrous misjudgments.

ATMOSPHERE OF VENUS CONTAINS NO OXYGEN

According to spectroscopic studies made at the Mount Wilson Observatory of the light received from Venus, says *Popular Mechanics*, no oxygen-absorption lines are found. This indicates that there is no oxygen or water vapor in the outer atmosphere of Venus, and furthermore that the reflected light of the sun must have penetrated to a considerable depth. It therefore appears necessary to attribute the great brightness of Venus to some other cause than that of high reflective power of water-vapor clouds, and this apparent absence of oxygen must be considered in connection with speculations as to the conditions of the planet.

FINDING PIPE STRENGTHS FOR USE AS COLUMNS

(Copyright, 1921, by W. F. Schaphorst).

STANDARD pipes often come in handy for use as columns or struts or for use as "push members" in transmitting forces. This is because a pipe is strong both in tension and compression. Due to its circular form it is ideal for resisting compressive forces.

However, when it comes to "figuring columns" it often takes considerable time digging around in handbooks, etc., and as a result the use of a pipe is avoided. Or, a pipe much too large or too small is used, chosen entirely by "guess." The pipe that is too small may fail and be the cause of disaster. It is always best, of course, to be on the safe side, but at the same time one should practice economy.

To assist those who may have occasion to use standard pipes in this way and to make it as easy as possible for them, I have developed the following simple table and rules:

1. Knowing the load that is to be carried and the length of pipe needed, make a "guess" as to the size of pipe. Column A in the tables will help in making the guess as it gives the maximum length of pipe that may be used. Thus, never use a one-eighth inch pipe, as an important column, longer than 14.5 inches. Never use a three-inch pipe, as an important column, longer than 139 inches, etc.

2. Multiply the length of the pipe in inches by the corresponding figure in Column B of the table. This product should never be greater than 12,000. If it is greater than 12,000 it means that you have guessed a pipe that is too small.

3. Subtract the product from 19,000. If the difference is equal to or less than 13,000 use

it, in (4). If the difference is more than 13,000 use 13,000 in (4).

4. Multiply by the figure in Column C corresponding with the pipe size.

The result is the number of pounds that the pipe will carry as a column, strut, or "push member." If the result is less than the load to be carried, try again, using the next larger pipe size, and so on until the proper and most economical size is selected.

Size of Pipes Inches	Column A Maximum Length Inches	Column B	Column C
$\frac{1}{8}$	14.5	826.4	0.07
$\frac{1}{4}$	19.4	617.3	0.12
$\frac{3}{8}$	25.	480.8	0.17
$\frac{1}{2}$	31.3	383.1	0.25
$\frac{3}{4}$	40.	300.3	0.33
1	50.6	237.5	0.50
1- $\frac{1}{4}$	64.7	185.5	0.67
1- $\frac{1}{2}$	75	160.5	0.80
2	94.7	126.9	1.07
2- $\frac{1}{2}$	114	105.3	1.71
3	139	86.21	2.24
3- $\frac{1}{2}$	161	74.63	2.68
4	181	66.23	3.18
4- $\frac{1}{2}$	202	59.52	3.68
5	226	53.19	4.32

For example, it is desired to support a load of 10,000 pounds at a height of 84 inches. What size of pipe should be used? Following the rules we do this:

1. "Guessing" the size of pipe, Column A shows that 84 in. falls between 1 $\frac{1}{2}$ in. and 2 in. pipe. We will therefore try a 2 in. pipe.

2. $84 \times 126.9 = 10,650$. This is less than 12,000 and we will therefore continue.

3. $19,000 - 10,650 = 8,350$. This is less than 13,000 and we may therefore use it in (4). If the difference were 18,350 we would have to use 13,000 in (4).

4. $8,350 \times 1.07 = 8,950$ pounds.

Since 8,950 pounds is less than 10,000 pounds a two-inch pipe is too small. We will therefore recalculate, this time trying a two and one-half inch pipe.

2. $84 \times 105.3 = 8,850$.

3. $19,000 - 8,850 = 10,150$.

4. $10,150 \times 1.71 = 17,370$ pounds.

This shows that a two and one-half inch pipe would be amply safe to hold up 10,000 pounds. It shows that a two and one-half inch

pipe is capable of holding almost twice as much as a two inch pipe at a height of 84 inches. The small difference in pipe sizes and the great difference in strength indicates the necessity of careful computation and the danger involved in guesswork.

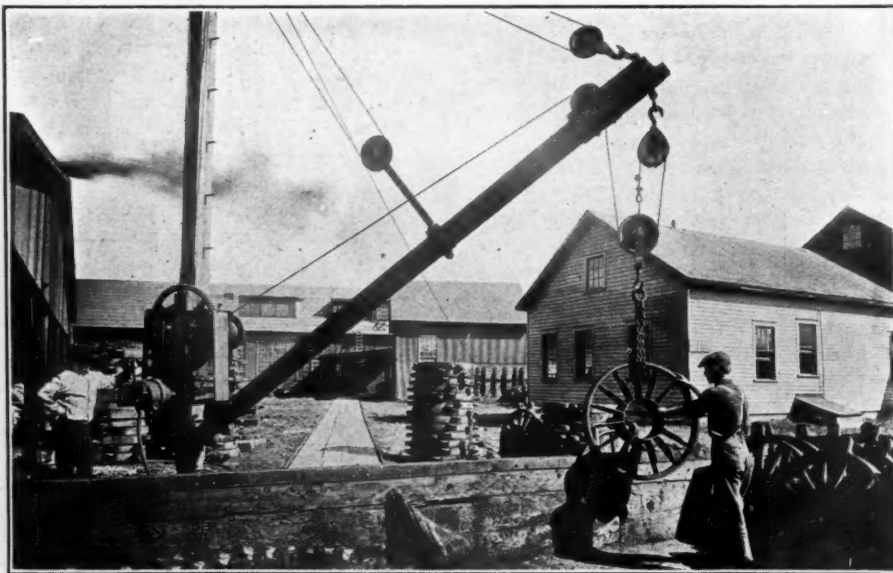
AIR OPERATED MOTOR FOR FOUNDRY

THERE IS a wide range of usefulness in foundries, machine shops, quarries, freight yards, etc., for motors of small power, that are economical and reliable in operation and which may be used for isolated and intermittent service without skilled attendance.

The illustration shows a compressed air stationary motor operating a crane. The loads handled by this jib crane are usually of the ordinary weight of car wheels, i. e., 600 and 800 lbs. This particular motor is made in several sizes, the largest of which will handle five tons. The air pressure used is about 85 lb., and the gear reduction between motor and drum which winds up the rope on this Sayre installation is seven and one-half to one. In addition to this there is a sheave and block arrangement which gives an effective lever arm of three to one, which makes a total effective reduction of three by seven and one-half, or 22 $\frac{1}{2}$.

This motor was put in service in January, 1903, and according to the statement of the general foreman has been in almost continuous operation since that time. These motors are suited for any kind of work and operate with little attention. The design combines power with extreme compactness and they are always ready for immediate operation. The advantage of this motor recommends its use particularly for plants where compressed air is already present for other purposes.

The motor is wholly enclosed in a dust-proof, oil-tight casing, and is lubricated by the splash system. The motor may be mounted on floor, wall or post, or otherwise attached as may be most convenient. Either a pulley or a gear may be used on the shaft.



Stationary motor operating crane which has been in service nearly twenty years.

Pneumatic Tools in Foundry Practice

By Replacing Hand Labor with Air Operated Devices the Problem of Increased Production with Decreased Costs Has Been Solved

By JAMES W. ANDERSON

THE PRESENT day foundry, that basic and indispensable part of the metal industry, makes a very interesting picture in comparison with the foundry of yesterday.

The American foundryman has kept in step with the progress made in the kindred industries. He has appreciated the fact that manual skill required in many foundry operations, must be replaced by more efficient methods. Higher labor costs, low production, and inability to meet foreign competitors who are favored with cheap labor, have made it necessary to use every available means to reduce foundry costs, speed up production, and get a maximum percentage of good castings. As a result, the application of mechanical agencies to replace manual labor has been the solution of the problem.

Compressed air, the agency which, above all others, had made it possible for the present day efficiency, finds innumerable applications in the foundry. The chipping hammer, sand rammer, portable air grinder, core breaker, air drill, air hoist, jarring and molding machine, sand blast, vibrator and blacking mixer are some of the many air-operated machines which have proved conclusively their worth in making the present day foundry an efficient integral part of the metal industry. Let us consider the application of compressed air, starting in the molding department, thence to the pouring of the casting, and finally to the finished product.

The old method of sifting sand by riddle and screen involved a great expenditure of energy, compared to the air operated sifters now in use. The amount of sand sifted with the air sifters is about ten times that possible by hand.

To the foundryman the words "cope" and "drag" are synonymous to knife and fork, in that the one is practically useless without the other. The flask or frame into which the molder packs sand, are known as the "cope" and "drag." The lower one is known as the "drag" and the upper is termed the "cope." When the sand has been packed to the desired density, the two sections of the mold are separated and the pattern removed, leaving an impression in the cope and drag of the casting desired.

Until twenty years ago practically all foundries rammed their molds by hand. This method proved tedious and very expensive, because of the time required. Also the mold was not tamped uniformly throughout, thereby producing a poor product, such as overweight and oversize castings, very likely containing blow holes. Today the portable sand rammers, the power squeezing molding machines, the jolt ramming and jarring machines, all operated by compressed air, are producing molds of better quality, more economically than the old method of ramming.

The power squeezing molding machine and

THE adaptability of air operated mechanisms for foundry use has become generally recognized within recent years.

The installation of compressed air equipment is practically imperative where production of castings on even a moderate scale is required.

Perfection of product, greater production and decreased cost of operation are the chief considerations of the modern foundry manager and the pneumatic tool has proved to be the chief agency in accomplishing these results.

the jolt ramming and jarring machines have limitations. These are only adaptable for comparatively small castings where the work consists of the duplication of the same pattern in large numbers. The size of mold used on the above machines depends upon the possible sagging action to be encountered, and the expense necessary to the production of large patterns for this type of machine which are as a rule of metal, usually aluminum, because of its lightness and therefore are fragile.



Ramming molds for sinks with "Little David" pneumatic sand rammer.

Usually if the mold is of any size a sand rammer is used to butt off the tops of the power squeezed and jolt-rammed molds.

From the above statement we must not infer that on so-called duplication work the sand rammer is not adaptable, for the large manufacturers of such articles as standard sized bath tubs, who turn out thousands of these molds daily, find the results obtained by the sand rammer superior to that of the jolting, jarring and squeezing machines. This is due to the fact that with the sand rammer the density of packing of the sand in the different parts of the mold may be varied, which cannot be taken care of with the other types of machines and which is necessary for obtaining a good quality in this kind of casting.

The sand rammer is of two distinct types—those used for bench work and known as bench rammers, and those adaptable to floor work, called floor rammers. The general design of both is alike, differing only in that the floor rammer is of larger cylinder bore, a longer stroke and is equipped with an extension handle.

These tools give a uniformity of blow which cannot be obtained by hand tamping. The only actual work for the operator is the guiding of the machine over that part of the mold he desires to tamp. These machines carry either a butt or pein on the end of a piston rod depending upon the shape of the mold to be tamped.

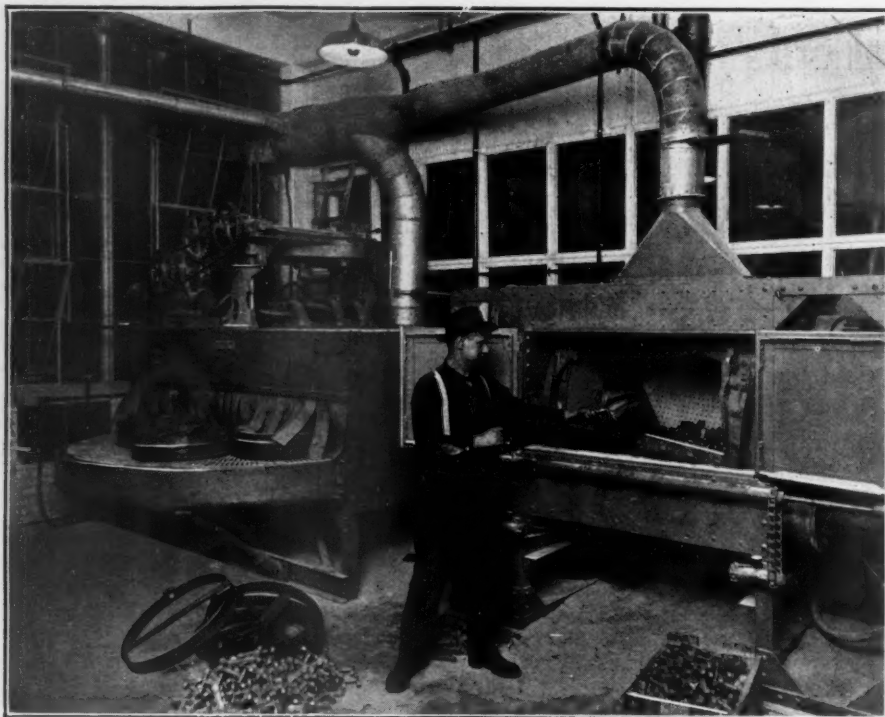
Many tests have been run relative to the comparative time saving of the pneumatic sand rammer, over the hand tamping, and results have shown it possible to ram five equal sized molds with the pneumatic rammer to one by hand. The average hand tamped blow is eighteen foot pounds, or approximately 720 foot pounds of work per minute, while the sand rammer delivers 28,000 foot pounds per minute, or a ratio of forty to one over the hand tamper.

The speed of operation of the sand rammer depends upon the weight of the moving element, namely the piston, the condition of the packing gland in the bottom of the cylinder, also the wear occurring in the moving parts between piston and barrel bore, and between the valve and valve block.

The weight of the piston is made a minimum by the manufacturer in hollowing the piston head and as light a piston rod as possible is used, while still retaining the necessary strength and durability.

Care should be taken not to allow foreign material, particularly sand, to be drawn up through the packing gland into the cylinder bore, thereby causing a wearing of the moving parts and an appreciable loss in efficiency of the rammer.

Approximately twenty years ago, Ingersoll-Rand Company developed the Crown pneumatic



Courtesy, W. W. Sly Mfg. Co.

Sandblast installation consisting of a barrel and an automatic rotary table. The type of work sandblasted by these machines is shown in the photograph.

sand rammer, and the original machine was such a success that its design has remained practically the same, and today it is the standardized rammer of nearly all the large users of this type of pneumatic tool.

The life of service of the pneumatic rammer depends upon the care taken by the user and the possible service offered by the manufacturer. In figuring the initial cost of a sand rammer or any other pneumatic tool, there must be taken into consideration the service offered by the manufacturer such as acquiring spare parts from the nearest branch stocks. Other items worthy of consideration are the materials used in the tool's manufacture, the manufacturers' facilities for treatment of wearing parts upon which really depends the up-keep costs and eventually the life of the tool. After a rammer has been in service, if it is placed on a rack, immersed in carbon oil and if, when placed in service again is oiled through the throttle handle, the life of the machine will be increased materially.

After the mold has been rammed, the convenient blow gun allows blowing off mold sur-

faces and getting loose sand and foreign material off the flask.

The mold is then ready for its film of blacking, which material is used to produce a clean casting by segregating the molten metal from the sand. The old method of brushing this on or painting with a hand operated atomizer, has given way to the compressed air operated atomizer, which gives better results on account of the evenness of covering. The blacking may be produced from its dry state by means of a tank to which an air supply is connected, which has the action of an agitator, and therefore assures an even mixing.

The "cope" is then ready to be placed on the "drag," and the flask is moved to a position to receive its charge of molten metal, which will conform to the impression in the mold contained therein. Great care must be taken not to disturb the mold during this operation. Therefore, it is necessary to have a hoist with minimum vibration, a steady lift and a very exacting control. The air hoist with perfectly balanced motor, valve in crank and worm gear drive, is far more satisfactory than the cylinder hoist, the regulation and control of which is very uncertain, due to its construction.

This type of hoist is also much superior to the electric hoist as it is not only much smoother in operation and affords more delicate control but is also practically immune from troubles arising from dust and heat, two foundry conditions which are very severe on electric hoists.

In some of the smaller foundries where the distance from cupola to the most distant pouring point does not exceed 125 feet, and the combined weight of the ladle and molten metal is not over five tons, the air motor hoist is used both for cupola charging and distributing the metal in the ladle to the various molds.

The best method of taking care of long lengths of hose when the air hoist operates over a long runway, is to tie ordinary awning pulleys on the hose at intervals of fifteen feet, and have these pulleys operate on a wire over the length of run of the hoist. This is known as the fold-over method of hose control.

Along with the above uses, the hoist will serve very well in handling materials in and out of the sand blast room. The air motor hoist being totally enclosed, is immune from injury by flying sand, and in some of the large foundries where a monorail system with a number of these hoists have been installed, the amount of material possible to be handled in the sand blast room has been nearly doubled. Also on the cleaning floor, the shifting of castings by means of these hoists, which are made in capacities up to five tons, has saved the installations of overhead cranes or relieved the ones already installed for other operations on the floor and at the annealing furnaces and cupola, where delay is expensive.

Some of the newer foundries have installed oil burning furnaces which require compressed air to atomize the oil and in some of the old type furnaces, low pressure air is used for induced draft.

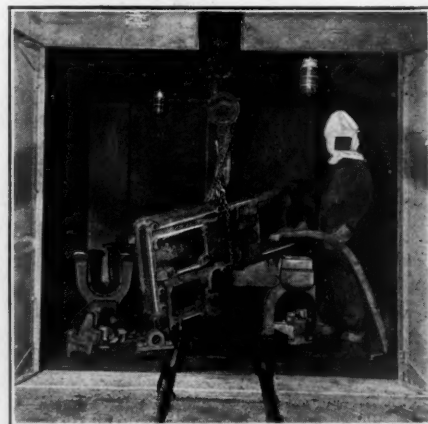
Oil torches with air atomizer are used for heating of ladle to prevent chilling of the molten metal. Oil furnaces for baking of molds are also equipped with compressed air.

The flask has been placed in convenient position and the mold has received its molten charge from this ladle. Upon cooling, the casting is then ready to be cleaned, the amount of cleaning and the finishing of the casting depending upon the use to which it is going to be put, and the character of the casting itself.

The breaking of cores, or what is termed "core busting," usually requires a pneumatic tool of considerable power, due to the cores being baked very hard by contact with the molten metal. The core breaker is a tool specially designed for this work, although chipping hammers of 4-in. stroke, and, in case of very deep cores, riveting hammers of 6-in. stroke, with specially devised steel retainer, have proved very efficient. The necessity of a heavy hitting hammer for this work is due to the fact that steels five or six feet long are necessary in some cases to reach the bottom of



Cleaning crank case castings with a "Little David" pneumatic grinder. Such portable grinders are extensively used for cleaning work.



Courtesy, W. W. Sly Mfg. Co.

Sandblast room. Of particular interest in this room are the provisions made for handling castings: First, the overhead monorail, and second, the car tracks on the floor.

the core, and the power of blow must be sufficient to be transferred through this length of chisel and still do the necessary work. The core in the iron casting is usually quite easy to dispense with, and the resultant hole will need very little cleaning. In all cases the regular core breaker will handle iron casting cores.

The cores encountered in steel castings are much harder, and regardless of the blacking used, a certain amount of steel and sand will form a conglomerate mixture, because the much higher degree of heat of the steel in comparison with the iron casting, and also the core itself will be baked much harder. In such cases the 4-in. stroke chipper, or in some instances, a specially adapted riveting hammer, is required before the desired result is obtained. After the cores have been disposed of, the chipping hammer, portable air grinder and sand blast put the casting in shape to be shipped to customer, or turned over to the machine shop for machining to the desired finish.

The chipping and cleaning of steel and iron castings is somewhat different. The iron castings usually reach the chipping floor comparatively clean except for fins and oversizes, the sand and other adhesion, such as a mixture of sand and a metal which are usually in large quantities on a steel casting, due to the higher heat of the molten metal, are seldom encountered with iron castings.

The actual chipping of iron and steel castings differs in that the iron is brittle and breaks under a comparatively light blow, while the steel is tough and it is necessary to drive the cutting edge of the chisel through the metal.

On the general run of iron castings, a 2-in. stroke hammer will suffice. On rather light fin, a 1-in. stroke hammer will handle the work. The steel casting requires a hard hitting hammer and a 3-in. stroke tool is the best adapted.

One cannot but appreciate what the pneumatic chipping hammer has done for the foundry cleaning department, how the old hand method of hammer and chisel, which was in vogue not so many years ago, compares with the present day methods.

A fair example is that of a roll which under the old hand method required several men a week's time to clean; this work is done today



Courtesy, W. W. Sly Mfg. Co.

Battery of three sandblast barrels used for sandblasting bronze castings.

by two men, in six or eight hours, with 3-in. stroke chipping hammers. Without a doubt the steel casting, which in the past ten years has replaced the iron casting on many classes of work where strength and durability were desired, owes a good part of its present position to the air operated chipping hammer. We are producing steel castings today that could not have been chipped before the advent of the pneumatic chipper. The ease with which the operator may guide his chisel while using the air hammer, allows him to put almost a right angle bend in the chisel, thereby allowing ports and other obscure parts of a casting to be chipped, which chipping could not have been accomplished by hand. Also the costs of chipping the present day large steel castings by hand, would make the use of iron necessary. The best method of determining which make of tool is best fitted for the class of work is by actual test. One of the largest foundries, with a very efficient cleaning floor, arranged what is known as a block test, taking a piece of steel casting whose constituent character was similar to the average of the general product. Each manufacturer's tool was placed on the same block and the metal chipped over a set time was weighed. This test was made when these hammers were new, and it was again repeated after six months, thereby giving the per cent. of decreased efficiency of each tool.

The best machine for the work was easily selected from data obtained from this test, and it is interesting to know that the yearly saving in the selection of the right tool meant approximately \$60,000.

The comparative initial cost of chipping hammers is an item which should carry very little weight, due to the fact that the expense of the cleaning and chipping department will depend entirely on the amount of castings cleaned per man per day.

The chipping hammer must be kept in good condition if the user is to obtain the best results. In the foundry, due to the foreign material present, the life of a chipping hammer is

necessarily shorter than in the billet yard or railroad shop. The operator must not allow the chisel to play away from the hammer or the result of the piston hitting the piston retaining wall in the barrel will cause irreparable damage, either by cracking of the barrel or breaking of the bridge.

A few other precautions such as keeping a good fitting nozzle in the hammer, oiling and cleaning periodically, and making use of the oversize parts which the manufacturer will furnish to replace the parts most subject to wear, will guarantee the user a longer life and more efficient service from his chipping hammer.

After the casting has passed the chipping floor, and its use requires it, the sand blast gives it the desired surfacing or finish. The sand storm of the desert cannot compare with the artificial effect of sand propelled by compressed air in its effort to surface and clean a casting. The time saving with the sand blast over the old hand methods make it possible for the user to save the cost of equipment in a very short period, by means of reduced cleaning charges.



A pneumatic sand rammer working on bath tub molds.



A two-ton air motor hoist used for lifting and transferring molds and castings.



Chipping steel carriage for 14-in. mortar with "Little David" chipping hammers. Pneumatic chippers are indispensable for such work.

The old method of using the sand blast was crude and unhealthy, but today the separate compartment for machine and operator and casting to be cleaned, the sand sifter, dust arrester and exhauster insure proper ventilation and protection for the operator. The tumbling barrel with compressed air is an efficient method of cleaning small castings.

Enamel ware, such as bath tubs, sinks, wash stands, etc., are made of cast iron coated with enamel. The coating of this ware is accomplished by heating the casting something below a white heat, and sifting the flaked enamel on to it, which, when it comes in contact with the hot metal, glazes. The sifting of the flaked material is important and must be evenly distributed. This is done by using a small pneumatic hammer with a stroke of $\frac{1}{2}$ in. or $\frac{3}{4}$ in., to vibrate an enamel dredge, the mesh of which depends upon the grade of flaked enamel used.

The latest development is the air operated

wire brush machine, which may be used for cleaning of castings, and on chills. This type of machine has proved more efficient than hand methods. This same machine is capable of being used as a pneumatic grinder, carrying a 6 in. by 1 in. emery wheel.

Just so long as the American foundryman is interested in cheaper production costs, so will the uses of the pneumatic tool be increased. As we look into the future with its ever increasing endeavor for maximum efficiency, we see the pneumatic tool and the use of compressed air playing a leading role, and its application increasing accordingly.

WAR GASES FOR KILLING BIRD PESTS

The Biological Survey in coöperation with the Chemical Warfare Service is to experiment with poison gases for the extermination of obnoxious birds, rodents and insects. There will be a trial this fall upon the blackbirds in the Imperial Valley of California. Because of their feeding habits it is impossible to destroy them with poisoned bait, but as they roost on the reeds in the marshes it is thought they can be killed by a gas cloud at night when the wind is favorable. It is impossible to avoid the killing of a few other birds at the same time, but it is believed, or hoped, that these local birds will soon reach their normal numbers again.

INSTANTANEOUS FINISH OF A GREAT JOB

ON APRIL 8, at a trap-rock quarry at Havlock, Ontario, a single instant gave the touch of complete success to a great engineering undertaking. Thirty tons, 60,000 pounds, of dynamite, distributed over an area of about one acre and fired at once, broke 200,000 tons of rock, shattering the entire mass so that only a small portion of it will require secondary blasting to enter a 48 by 60 in. crusher, and not a bit of rock flew more than a hundred feet away.

This blast must go on record not only for its

magnitude but also for the complete success of it. It is an achievement of the highest engineering skill and judgment and of minute adjustment and enforcement of detail. If the charges had not been correctly placed or if the connections for the firing had not been completely adjusted more or less of failure would have resulted. So, too, we might say that if ten per cent. more of dynamite had been used a large part of the rock would have been sunk in an adjacent swamp, and if the charge had been ten per cent. less the rock would hardly have been moved which would have been a failure in the other direction. The details could not have been figured out in advance from any text-book, and their determination must have been after all a species of sublimated guess work, as was also the risking of the \$35,000 which was the cost of the work.

AUTOMATIC INDUSTRIAL VENTILATION

A unique ventilation equipment was recently installed in London at a large film studio. Frequent fogs and tendencies to haze in the atmosphere cause great expense and delay in the taking of film pictures. In order to ensure continuous working an automatic system of warming and damping the atmosphere of the building was designed. All the air entering the studio is washed, filtered, and warmed; and the control is so arranged that whatever change of temperature or condition of the outside air takes place the inside air is altered in such a way that no fog is produced. The control is so delicate that even the switching on of one or two lamps in the studio meets with an immediate response by the automatic plant. An endeavor is now being made to remove from the incoming air various gases which are contained in a London fog. These gases have no effect on the photographs taken, but they cause headache and lassitude among the performers. It is claimed that this apparatus solves the problem of continuous film production in Great Britain.

NEW HIGH EXPLOSIVE

ASSISTANT TRADE Commissioner Bernard H. Noll, in *Commerce Reports* recently, tells of a new high explosive which has been discovered in Brazil and is named brazilite. It is claimed that it does not give off gases injurious to the operator and in experiments it has resisted without deflagration all mechanical and chemical tests. In one experiment 5,650 g. was placed in a bored hole 4 m 65 cm. deep, and the charge displaced 200 cu. in. of granite.

THE FOLLOWING comes to us from London and tells its own suggestive story: At 11.30 one morning Mr. F. H. Jones, of the firm of D. Napier & Son, received a telegram from Paris asking him to bring over some documents relating to the building of a Lion engine. Taking his swiftest motor car he rushed to Croyden, caught the 12.15 air liner and delivered the papers in Paris by 3.30. Doubtless he had his lunch on the way and attended to miscellaneous business by wireless—or could have done so.



Smoothing-up the surface of a large casting with a pneumatic grinder.

Pneumatic Clay Diggers Speed Sewer Tunnel Work

The Development of Air Driven Clay Diggers Eliminating Picking or Blasting, Makes Possible Record Progress in Tunnel Driving

By R. A. LUNDELL

DURING THE past eighteen months or more the use of compressed air has been extended to an important and interesting field of operations, namely, the driving of tunnels through clay and hard soil. While this power medium has long been indispensable for tunneling through rock, or through soil requiring air lock methods, its use has but recently been applied to tunnel operations in stiff clay and similar material. With the aid of compressed air and through the ingenious employment of special pneumatic hammers, the driving of sewer tunnels has been greatly expedited and the cost of the work considerably reduced.

In the city of Detroit, in particular, where an immense amount of sewer tunnel work has been under way, the use of these pneumatic clay diggers has been highly developed. However, they have also been used with pronounced success on similar work, in and around Chicago, and also in certain Eastern centers.

Excavation in stiff clay, hard sand or fine gravel is ordinarily laborious and expensive where steam shovel, or trenching machines cannot be used, and the material must be loosened for removal by means of hand picking or blasting. For such work as tunneling, trench digging, etc., some method has long been needed that would eliminate the necessarily slow hand picking and enable the work to proceed at a much faster rate.

Compressed air through its adaptability for hand tool operation has again been found the most satisfactory means for reducing this tedious and costly manual labor. The blows of the air driven hammer have replaced the swing of the hand pick, here as well as in many another operation.

A type of these air driven clay diggers is shown in an accompanying illustration. The general construction of the tool is more or less evident from the picture, it consisting essentially of a long stroke pneumatic hammer, fitted with a digging blade held in place by a retaining device. In operation the blows of the hammer drive the blade into the ground, prying loose the material so that it may be removed. The method of using these tools in stiff clay, is to slice the clay, as can be seen from the illustration.

The air hammer shown, as manufactured by the Ingersoll-Rand Company, is an adaptation of a rugged type of tool that has proved successful, in the past, on work of a somewhat similar character—such as coal-picking, breaking out light concrete, corebreaking, etc. It should also be noted at this point, that this clay digger hammer is not limited to the employment of a digging blade only, but, that the latter may be easily removed and a bull point chisel substituted, if gravel, boulders or hard pan be encountered.

That the use of these tools has been readily adopted by contractors, is shown by the fact, that the Ingersoll-Rand Company reports about 150 of these "Little David" clay diggers are in use in and around the city of Detroit alone.

Records received from contractors using these tools, show that the amount of work done per man has been increased from 100% to 150% over the rate when the hand pick and shovel were used. Contracts have been completed considerably ahead of time and at a very satisfactory profit by the employment of these air diggers.

Using old hand methods in tunnel work through clay, a man was able to move only from four to six cubic yards of clay per shift of eight hours, whereas with the aid of one of these pneumatic clay diggers, the same man could attain a rate of $8\frac{1}{2}$ to eleven cubic yards for the same period of time. A rate of work has often been reached that has had to be limited because of inability to dispose of the muck as fast as it could be loosened.

Soil conditions encountered in the Detroit district vary greatly, running from a very soft pumice-like clay to very hard clay, and in between these extremes a great many things are met. For instance, in one section of the city, about two miles from the center, clay of uniform, medium hardness, but full of sand pockets is encountered and requires very careful mining. Here the pneumatic clay digger proves of good advantage. By the old hand type of mining, using the monkey-hole and power or hand knife, the work was hazardous on account of the danger of caving in. By using the pneumatic diggers the miner could feel his way along and timber when necessary to hold the top.

In another section less than a mile away, where a ten-foot six-inch diameter finished sewer is even now being built, the clay is extremely hard and no other method of mining has proved anywhere nearly as successful as the pneumatic clay diggers.

On this particular job they are using six diggers to the heading and are getting approximately eleven cubic yards per man per day; in other words, for the six men, approximately 66 yards for an eight hour shift. The best that they have been able to do without the air driven tools was four to six cubic yards per man per day. Under the most favorable conditions on this job the men have reached the surprising rate of sixteen yards per man per day.

On another nearby tunnel job just recently completed, the contractor averaged seventeen lineal feet of tunnel per day of eight hours with four miners (hammer men), the tunnel being approximately nine feet diameter. This was an average of about eleven cubic yards per man for each of the four miners employed. The material in this case was mostly a medium hard blue clay, which held up very good, no bracing or timbering being necessary to hold the roof. The conditions met with in this tunnel were of course also excellent, but the figures show what really fine results have been possible.

Incidentally, better ventilation in these tunnels was maintained because of liberated air from the exhaust of the tools. Even when the tunnels were driven in far from the shafts, good working conditions were secured by the exhaust, without use of any fans or blowers.

On still another sewer tunnel of larger diameter in the same territory, an average progress of over fourteen feet per day has been reported. This tunnel was fourteen feet outside



Close up view of one of a number of 56-H "Little David" clay diggers at work on a Detroit sewer tunnel job.

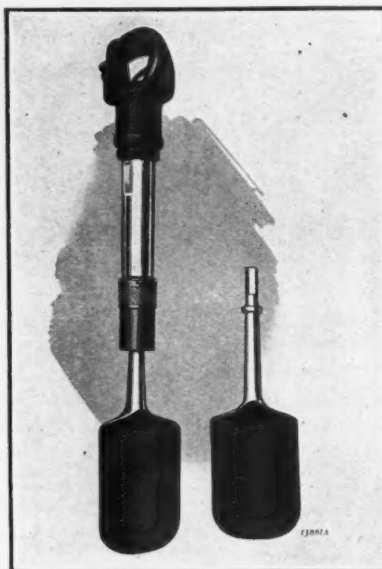
diameter. With four miners, four muckers and one car man the tunnel was driven forward the distance stated each eight hour shift. The tunneling gang here was followed immediately by the masonry gang who put up the brick lining. Overhead conditions of course were fairly good so that the masons could follow along and place the brick work. Excavating was usually done during the day and the masonry at night. This meant that the passing of each twenty-four hours saw the completion of over fourteen feet of finished sewer.

Another sewer tunnel, in which these compressed air tools were used, but under different conditions, was recently put through at Flushing, Long Island. The material encountered was soft clay, with streaks of hard pan, gravel and numerous boulders of various sizes. The digging blades were used to good advantage in taking out the clay while bull points were fitted in the hammers for working in the hard pan and around the boulders.

Because of the varying soil conditions, no accurate progress records were possible. Many large size boulders frequently obstructed the progress of the work, but they could usually be loosened and carried outside. One such obstruction, a six ton boulder, had to be "shot" before the work could proceed.

This tunnel, put through by the O'Rourke Engineering & Contracting Co., was 9 ft. 3 in. in diameter, 2000 feet long and was lined with segmental concrete blocks, seven to a ring. Firm support was required for the sides and roof so the contractors used a steel shield, pushed forward by hydraulic jacks as the work progressed.

Two pneumatic diggers were operated just ahead of the shield and lifter, there being usually only four to five feet of working space. Ordinary hand picks would have been very awkward to handle in such narrow quarters, and the air tools were found much more convenient and speedy.



No. 56 H "Little David" clay digger such as is extensively used in sewer tunnel work.

As fast as the clay or hard pan was mined and mucked, the supporting shield was jacked forward and concrete rings built up. The inside diameter of the tunnel then became seven feet three inches.

It is interesting to note that on this tunnel job compressed air served for other purposes besides operating the shovels and promoting ventilation. Compressed air at 70 to 100 lbs. pressure was used to blow gravel behind the concrete rings immediately after they had been placed, filling up any empty spaces so that the rings at once helped to support the ground above. Suitable threaded holes cast in the concrete segments provided means for connecting the air lines. That this method was effective in supporting the overlying ground was evident, because at a later date no surface settlement was observed.



A view 35 feet underground in a sewer tunnel driven at Flushing, Long Island. "Little David" clay diggers were operated just ahead of the hydraulic shield. The uncertain character of the soil required careful bracing throughout.

Grouting was accomplished in a similar manner by blowing in with air. This operation, however, was performed but once a week, when a series of rings were treated one after the other. An air motor was also used to drive a small mixer.

At the present time there has been completed in the city of Detroit, thousands of feet of sewer tunnel and thousands of feet are still to be driven. In the carrying out of these tunnel projects compressed air and the pneumatic clay digger apparently have become an indispensable part of the contractor's equipment.

It is worthy of mention that in this vicinity a number of contractors, being skeptical of the pneumatic clay diggers, went along for over a year without using them. Practically every one of them have now purchased and are using these diggers, having found that their use has cut the cost of doing the work at least 40 per cent.

STEADY WORK FOR THE PAINT SPRAY

The paint spraying process has been a long time in working into steady employment, but it may now be considered a fixture at least in railroad shops. Some roads, says *Railway Age*, have developed paint spraying to such an extent that a large proportion of all equipment, including both cars and locomotives is painted in this way.

The essential advantage of spraying is the greater speed with which surfaces can be covered, but it is often possible to utilize a lower priced operator than would be necessary with brush painting and the total reduction in labor cost is increased proportionately. Paint can readily be sprayed in corners and crevices which would be difficult, if not impossible, to reach with a brush; and with the proper precautions practically no paint is wasted. While more paint is required to cover a given surface with a spray as compared with a brush, one coat applied by the former method is said to be equal to two applied by the latter and there is a saving of material as well as labor. It has been found possible to spray varnish in which case an enamel finish is secured and this fact has broadened the field of painters spraying to include passenger as well as freight cars. The possibilities of economy may be appreciated by consideration of a typical example. A box car has been spray-painted by one 54-cent man in fifteen minutes, whereas it would take a 72-cent man about four hours to apply the paint with a brush. The relative amounts of paint used are nine and eleven gallons.

To finance the construction of a light railway from the Tzelitsing salt wells to Luchow on the Yangtse River, a distance of about 66 miles, it is reported by Vice Consul Allman at Chungking that a provisional loan agreement for \$4,000,000 (Mexican) has been signed between an English firm and a Chinese representative of salt merchants and other private interests. The loan will be issued at 94 with interest at one per cent. per month, to mature within fifteen years.

American Salvors Re-establish Their Pre-eminence

Unrivalled in Their Applications of Compressed Air—The Salving of the Oil Tanker "F. D. Asche", A Remarkable Feat

By ROBERT G. SKERRETT

BACK IN the good old days when the belly-
ing sails of our beautiful clipper ships were
en everywhere upon the Seven Seas, Amer-
an salvors followed the flag and saved our
grandest craft wherever it was humanly possible
to do so. During that glorious period of a
quarter of a century—beginning in the early
forties," our maritime wreckers won for them-
selves an enviable reputation among the nauti-
cal fraternity. Their skill and daring in hand-
ling dangerous problems placed them at the
forefront of the calling.

But with the advent of the steamer and the
opening of the Suez Canal, our clipper ships
lost out in the race against time and the practi-
cality of commerce. One by one, those master-
pieces of timber and wonderful lines disap-
peared; and with this decadence of our mer-
chant marine the Yankee salvors ceased their
activities abroad and dwindled to a mere hand-
ful of workers along our own coasts. True, as
our shipping developed later on, wrecking com-
panies came into existence, but these enter-
prises, although commanding facilities undream-
ed of in the "forties" and "fifties" of the nine-
teenth century, achieved for the most part noth-
ing that marked them better than their com-
petitors elsewhere the world over. Even so,
native ingenuity was leavening our salvage prac-
tices, but to what extent was not generally rec-
ognized until Europe was well in the throes of
the titanic conflict.

In the years of the World War, our maritime
service suddenly assumed splendid proportions;
and for the safety of these ships, after we
joined forces with the Entente Allies, the Gov-
ernment organized a salvage division. The
men and the vessels in this service did effec-
tive work in French, English, and Italian wa-
ters. These wrecking steamers were outfitted
in an unusual manner, and were especially
equipped to utilize compressed air on a large
scale for the raising or refloating of sunken
or stranded craft.

With the completion of the return-troop
movement, and with the continued activities
abroad of numerous ships flying the Stars and
Stripes, the officials of the U. S. Shipping
Board very sensibly decided to establish Amer-
ican salvage bases on the other side of the At-
lantic. To this end, stations were instituted
at Falmouth, England, and in the Azores. A
similar course was pursued down in the Gulf
of Mexico, so that vessels bound to and from
the Panama Canal or operating in West Indian
waters might be promptly succored in time of
need. The wisdom of this action has been
demonstrated, and strikingly so in the case of
the American freighter *Black Arrow*, which
was driven ashore in the summer of 1921, on
the northwest coast of Spain—just around the
corner, so to speak, from the treacherous Bay

of Biscay and exposed to the full force of the
Atlantic.

The *Black Arrow* was swept high on the
rocks of Cape Vilano, to the northward of Cape
Finisterre; and her predicament was such that
various European salvage companies looked up-
on her as a hopeless wreck. Indeed, the prices
which they quoted for her relief were prohibi-
tive. Then it was that the Shipping Board sal-
vage steamer *Warbler* was dispatched from the
Azores to undertake a seemingly impossible
task.

On the 15th of August, 1921, the *Warbler*
arrived at the scene of the disaster. Undis-
mayed by the situation, the Americans went
right ahead to discharge the cargo and other
dead weight from the *Black Arrow*; to tem-
porarily patch some of the hole in her damaged
hull; and, incidentally, to place upon the deck
of the stranded ship a number of powerful
pumps. Not only that, but holes were actually
burned by means of oxy-acetylene torches in
the vessel's steel sides so that the sea might
enter some of the compartments to offset masses
removed and thus to lodge her firmly upon the
reef and to keep her from pounding at high
tide, when the waves were running shoreward.

Finally, when all of the preliminary opera-
tions were finished, and divers had secured col-
lision mats over the submerged openings in the
hull, both the wrecking pumps and compressed
air were brought into play to drain the *Black
Arrow* and to lighten her sufficiently to enable
the *Warbler* to pull the steamer sternward clear
of the rocks and out into deep water. This cli-
max was reached on the 30th of August—after
working night and day for two weeks whenever
the weather permitted.

The *Warbler* carried no fewer than five air
compressors, one complete air-lock, a group of
air tanks, and numerous pneumatic tools. In
addition to this outfit, the salvage steamer had
an array of diving gear, and a large group of
portable wrecking pumps. The boat had aboard,
besides, dynamite for blasting, oxy-acetylene
welding and cutting apparatus, submergible
lights, many fathoms of wire and hempen haws-

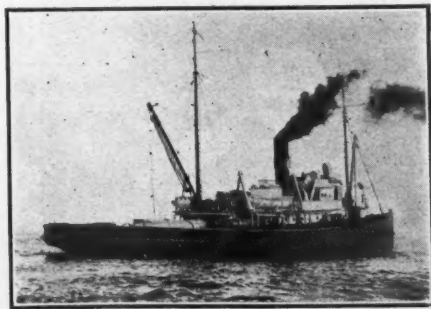
ers, spare anchors, chains, etc. These de-
tails are mentioned that persons unfamiliar with
the subject may realize the diversified way in
which an up-to-date wrecking vessel must be
appointed and made self-sufficient to meet well-
nigh any situation which might develop when
in action far from a base of supply. The
Warbler, which is typical of a group, was built
by the Government in 1920. She is about 182
feet long, is of 715 gross tons, and, at an aver-
age speed of ten knots, is capable of steaming
5,000 miles when her tanks are filled with 60,000
gallons of fuel oil.

The function of compressed air in saving a
ship wrecked at an isolated point has probably
never been more vividly exemplified than in the
case of the oil tanker *F. D. Asche*, which was
driven by the seas of a subsiding hurricane onto
a coral key at the northern limits of the Bahama
Islands last October.

This vessel is of 11,790 tons deadweight ca-
pacity, and represents a climax in her partic-
ular branch of naval architecture, being of
notably sturdy construction. This vessel left
New York, in ballast, on the 20th of October,
bound south to certain Texan ports for a cargo
of crude oil. Three days later, while feeling
her way toward the Strait of Florida, she re-
ceived warning of a hurricane moving north-
ward and having its center over Yucatan Chan-
nel. The next day, the tanker was advised by
wireless that the track of the storm had shifted
and was advancing over the west end of Cuba
from the southeast.

When she was about 70 miles to the north
and east of Jupiter, Florida, on the 25th, the
gale struck her, at 10.30 a. m., with full force,
and to guard against being blown on the coast
the steamer was headed directly seaward. For
seven hours she ran to the eastward at full
speed, but, fearing to intercept the center of the
hurricane, the *Asche* was swung about and
pointed into the wind. At that time, so it is
reported, the seas were mountain high, meas-
uring from crest to hollow quite 100 feet. For
96 hours the sun had been hidden, when at 8
o'clock, on the evening of the 26th, the captain
estimated the position of the tanker, by dead
reckoning, to be approximately three miles to
the north and west of Matanilla Reef, and her
course was laid to the south and west.

Slowly, the *Asche* steamed onward, taking
soundings at frequent intervals. An hour after
midnight no bottom was reached at 85 fathoms,
but as the sea was getting warmer it was be-
lieved that the steamer was in touch with the
eastern edge of the Gulf Stream. Still groping
forward in the darkness, everyone was startled
suddenly at 1.45 a. m. when the ship shook vio-
lently from stem to stern. It was immediately
evident that she had grounded. Her engines
were stopped; all tanks were opened to hold

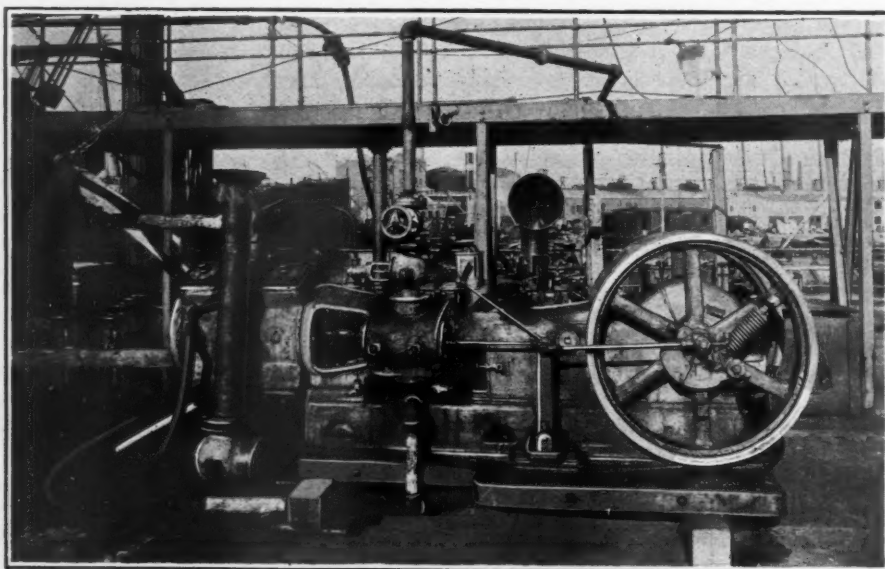


The Shipping Board salvage steamer "Warbler," based at the Azores, which was instrumental in refloating the big freighter "Black Arrow."



Courtesy, Todd Shipyards Corporation.

Beneath the "F. D. Asche" while in dry-dock and looking upward and forward into starboard tank No. 4. The pendant blanket indicates where the bulkhead was fractured and stuffed temporarily with newspapers and blankets. Both tanks 3 and 4 were filled with compressed air, but the pressure in No. 4 was slightly less than that in No. 3 and this difference sufficed to keep the obdurate materials in place.



Courtesy, Todd Shipyards Corporation.

One of the several compressors installed on the deck of the "F. D. Asche" by the salvors. These machines supplied continuously the compressed air required to expel the invading water from the ship's injured tanks so that she would float free of the coral reef.



Courtesy, Todd Shipyards Corporation.

Looking outboard from within tank No. 4 and showing how the side plating was mangled by the reef.

her, if possible, where she had struck; and both anchors were dropped to arrest her advance. Despite these precautions, the craft was brought to a standstill until the surging billow had impelled her nearly a mile right over coral reef—successively dropping her upon the underlying rocks.

When daylight dawned, and the sea moderated, the *Asche* was found to be well inside of the outer reef, and soundings at points around her disclosed five fathoms of water, although the vessel was held just beneath the bridge by a part of the submerged coral formation. As water was leaking into the fuel tanks and putting out the fires under the boilers, calls for assistance were broadcasted by radio; and relief was quickly dispatched from Key West. When the wreckers arrived, and divers were sent down to examine the tanker's bottom, it was discovered that the greater portion of her underbody was battered into a series of undulations as if the heavy steel plating had been crushed by a gigantic cogwheel. Pretty nearly all of her compartments were inundated, and the bottom of Tank No. 4 was torn loose—leaving a wound 30 feet wide and twenty feet long, fore and aft, while the adjacent side was ripped open to the height of eight feet.

The ruptured plating was seven-eighths of an inch thick; and some of this pendant steel, while still attached at one end to the hull structure, was caught below in a crevice in the reef. This served for the moment to tie the ship to the key, and added to the gravity of the task of getting her off. She would, in all, likelyhood, have been counted a total wreck but for the resourcefulness of the men sent to her aid. Compressed air, skilfully employed, made it feasible ultimately to refloat her and then buoy her up while she was being towed hundreds of miles to port.

To understand how this was done let us recall a familiar experiment. Most of us know that if a tumbler, upside down, be put in a basin of water, the water will not rise inside the glass beyond a certain point; no matter how deeply the tumbler may be immersed the water will not fill it. That is because the confined air becomes compressed, and is therefore able to hold the water at bay. In short, the salvors of the *Asche* converted, in effect, each of her big oil tanks or compartments into an inverted tumbler, and filled all of them with as much compressed air as they could hold. It was found that one pound of air pressure was capable of lowering the water level in each compartment a distance of approximately 28 inches.

The first thing that had to be done was to break the bond of steel that linked the craft with the reef, and this was no easy matter. After divers, at considerable peril, had hooked heavy chains to the pendant plating, a pull of nearly 100 tons was exerted by powerful hoisting engines to draw this steel work free; and just when the connecting heavy hawsers grew thinner under the strain and seemed about to snap, the rocks released their grip. Subsequently, the plating was cleared away by dynamite and allowed to drop in the depths of the sea.

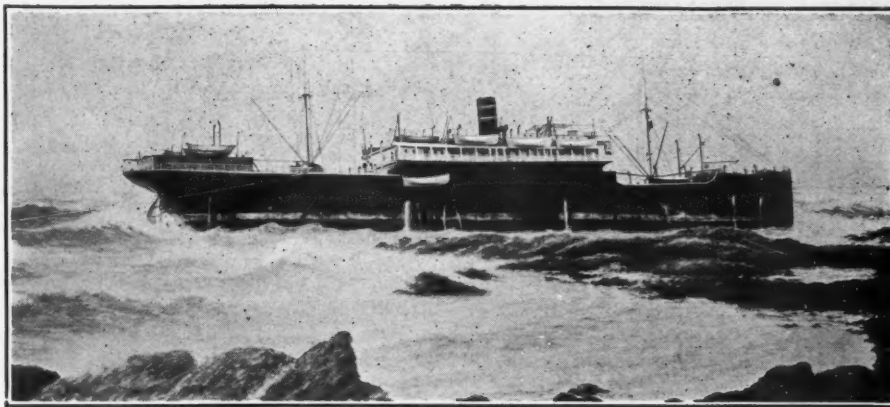
The next step was to turn compressed air into the several flooded compartments so as to force

the intruding water downward and outward until the waterline in each tank neared the uppermost break in the contiguous skin of the ship. This air was distributed to the various tanks by way of the existing mains provided for the handling of cargo oil. That is to say, this system of piping was linked with the compressors instead of with the vessel's pumps. To give the *Asche* sufficient buoyancy to refloat her, and to put her in a condition that would permit her to be towed to New York, it was necessary to close up some of the holes in her steel shell. This was especially the case with the bulkhead which stood between the bottomless compartment and the tank just forward of it. The lower part of this bulkhead had been crushed upward and bent back on itself like the fold of a bellows, and along the line of this fold the plating was cracked and gaping. The problem was to plug this somewhat inaccessible rent so that more compressed air could be blown into that otherwise moderately injured chamber.

To make this possible, an air-lock was secured to the upper deck directly over a circular hatch. The air-lock was a fairly roomy cylinder about eight feet high, set up on end, and equipped with two air-tight doors, one at the top and the other at the bottom—arranged to open and to close alternately. Workmen could then enter or leave the tank without letting the compressed air escape from the compartment. The break in the folded plating was plastered over, first with newspapers, and then with blankets, and these were held snugly in place by the volume of compressed air back of them. Gradually, as the wounds in the steelwork were closed in this fashion, the sea was forced out and kept out, and the vessel was given the additional buoyancy required to float her. Freed in this manner from the reef, and buoyed continually by a steady flow of air from oil-driven compressors set up temporarily upon the ship's deck, the *Asche* was towed without further mishap to port. Had her compressors failed, however, during that journey, she would have filled quickly with water and have sunk to the seabed like will not a stone.

When the *Asche* reached New York harbor and was dry-docked with difficulty at Brooklyn, it became apparent that the steamer was, for all practical purposes, substantially bottomless. That is to say, her plating was so damaged that she was as leaky as a sieve, and out of the hundreds of plates in her bottom only two of them were so moderately deformed that they could be faired up and made fit for replacement. Indeed, the hull injuries were so extensive that it was estimated that an outlay of about \$400,000 would be called for to put her in serviceable condition again. And at this stage there developed an exceedingly interesting phase of the matter.

The lowest bidder for her repair was a shipyard on the James River not far from Old Point Comfort, Virginia, and the question was whether it would pay to move her from Brooklyn down to the Chesapeake or to refit her for a larger sum where she lay. Under ordinary circumstances, the latter course would have been followed; but the successful application of compressed air in keeping the tanker afloat on her trip northward from the Bahamas made her

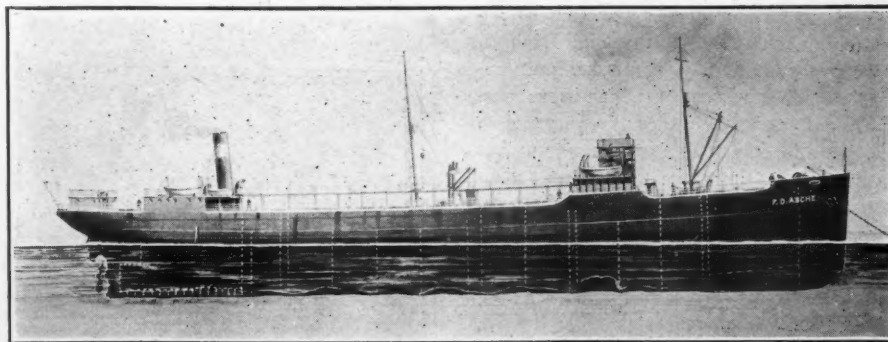


The S. S. "Black Arrow" upon the rocks of Cape Vilano, Spain. The rugged character of the coast, exposed to the full sweep of the Atlantic, added to the perils of the ship and the difficulties of refloating her.

owners willing to gamble with fate. Therefore, she was undocked and towed out of New York harbor on the 14th of January.

Again, her compressors were brought into play, and, during the run to the Virginia Capes and thence up the James, they furnished continually a supply of buoyant air ample enough to hold the intrusive sea at bay until the craft was again safely landed upon the blocks of a drydock at Newport News. The undertaking was a venturesome one; but the sturdy structure of the boat helped to make more reliably positive the action of the sustaining compressed air; and then, fortunately, the weather was favorable.

It is worth while recalling that compressed air was first used effectively inside of a sunken ship to refloat her only fourteen years ago; and that performance was made possible after rather extensive preliminary work. Not only that, but the craft lay in the comparatively sheltered waters of the St. Lawrence, where the task could be attacked deliberately. Indeed, the raising of that steamer was not generally acknowledged as a precedent that could be followed with confidence in essaying the average job of the marine wrecker. The salvaging of the *Asche* indicates how the system has developed in the meanwhile, and emphasizes that the methods of using compressed air are now so flexible that a grievously injured ship stranded on a distant reef, exposed to the sweep of the open sea, may be got clear of the rocks and towed many leagues to a suitable haven with a minimum amount of preparation.



The "F. D. Asche" after she was pulled off Matanilla Reef. As the drawing shows, her bottom was gravely damaged throughout its entire length. At the point beneath the bridge, the plating of one compartment was torn loose, and looking down from a hatch it was possible to see right into the depths of the sea. Vertical white lines show positions of transverse bulkheads. The dotted white lines way aft indicate how boiler and engine foundations were forced upward and out of alignment.

COMPRESSED AIR GUN

Both empty and loaded cars are handled in an eastern mine by a clever system of inclined tracks, a switchback, and a 12-foot compressed air cylinder and piston, located between the tracks, which might properly be called a gun, as it actually shoots the cars into position on an incline leading to the hoisting cages. As described and illustrated in the *Popular Mechanics Magazine*, the gun or pusher, as the miners call it, is located 42 feet from the cages. The first twelve feet, the length of the piston travel, are upgrade from the pusher, and the remaining 30 feet down grade. When a loaded car comes within reach of the pusher piston, a fitting on the latter engages the axle, and as the piston moves outward, the car is pushed up the short grade onto the 30-foot incline to the cages. Dropping to the latter by gravity, the loaded car "kicks" the "empty" off the platform, and takes its place. The empty then rolls down an incline, past a switch and up another incline. Coming to a stop it rolls back, but is shunted to a track, reserved for empties, by the switch. A second pusher then moves it along to the point where the mine locomotive picks it up and hauls it to the workings.

"America will be producing oil for at least seventy-five years. America has used up approximately one-third of its visible supply. The rest of the world has a supply sufficient to stand the present drain upon it for at least 250 years."

LIQUID OXYGEN EXPLOSIVES

Although the use of liquid oxygen explosives has not made much headway in the United States, experiments made with such explosives by a metal-mining company at Pachuca, Mexico, operated by American capital, promise quite satisfactory results, according to observations made by a representative of the United States Bureau of Mines. From the beginning of the entrance of the United States into the World War, efforts have been made by George S. Rice, Chief Mining Engineer of the Bureau of Mines, to have liquid oxygen explosives tried out practically in this country. Owing to the fact, however, that no manufacturer in the United States makes oxygen liquefying plants, the use of these explosives in America has been quite limited. The development of this innovation so far has been largely German, and in Germany oxygen liquefying plants are manufactured in various sizes in complete units of apparatus and containers. Since the war the only extensive development outside of Germany has been in the Lorraine iron mines where the Germans installed apparatus, and additional apparatus has been put in by the French. One company in Lorraine is mining its entire annual output of 1,500,000 tons of iron ore by the use of these explosives. This company has developed a cartridge of its own on which it has received patents, and has applied for others. It is claimed that the cartridge is an improvement on the German cartridge. The Germans use in some cartridges, soot, and in others, wood pulp. Either fuse or electric detonators can be used for igniting the charge. The Germans have now developed a method of placing the electric detonator in the bottom of the hole in a special container and have been able to fire large rounds, it is claimed as high as 28 shots at a time.

GROWTH AND MAGNITUDE OF THE AUTOMOBILE INDUSTRY

The production of automatic vehicles now ranks second in the industries of the United States, being exceeded only by the steel industry. In 1912 there were approximately 1,000,000 automobiles registered in the United States. In 1913, there were approximately 240,000 more, which represented an increase of 25 per cent. This production of new cars has more than held constant since that time, reaching a maximum of 50 per cent in 1916 which corresponds to an increase in new cars of approximately 1,120,000. At the end of 1921 there were approximately 10,500,000 automobiles registered, 8,800,000 of which were passenger cars, or one passenger car to every twelve persons. In addition to this enormous number of passenger cars, there are more than 1,000,000 gasoline buses and trucks.—*H. L. Andrews in General Electric Review.*

A new device just developed by the Navy Department, and which makes possible the accurate measurement of any depth of the ocean, possibly will result, hydrographers say, in the charting of spots in the sea which have never been measured because their depth was too great for the old method of sea sounding work.

HAY CONDITIONER USES AIR MOISTURE

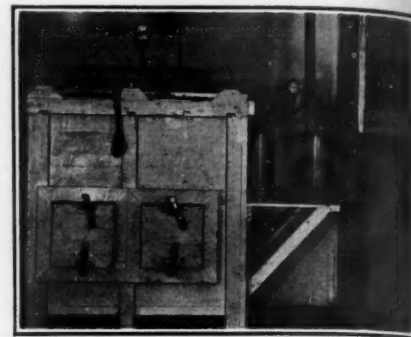
By S. R. WINTERS

GRADING OF HAY, even though the cured grass is as dry as the proverbial gun-powder can, is possible by the use of compressed air. An apparatus designed by H. B. McClure of the Bureau of Markets and Crop Estimates, U. S. Dept. of Agriculture, saturates dry samples of hay, subject to classification, with moisture to a degree which will permit of handling without shattering. Compressed air, as a means of imparting moisture to the atmosphere or to industrial materials, has long been used in humidifying apparatus of one description or another. For obtaining a certain degree of relative humidity in factories or other buildings where the work calls for more or less exact moisture control, air vaporizers have proved very satisfactory. In this miniature installation for moistening samples of dry hay, similar fundamental principles are involved. Compressed air is forced into the lower chamber of the hay-conditioning equipment where it takes on a load of moisture before being forced through a series of small perforated pipes and then into the sample of hay.

A laboratory or hay standardization office has been established by the Department of Agriculture at Alexandria, Virginia, where cured grass for feeding horses, cattle, and other domestic live stock is classified with respect to quality. Government standards have been fixed and the farmer and city dweller may in the future purchase hay according to well-defined grades.

Whether the hay grown and marketed for the consumption of Old Dobbin, Bossie, or other form of live stock is of prime quality and inviting to the palate is revealed by knowing the state of the product in a half a dozen particulars. Color, texture, mixture, condition, stage of maturity, and how well cured, are factors considered when grading is done. A study of color, for instance, enables the Department of Agriculture to ascertain the natural hue when grass is harvested at varying stages of maturity in different hay-producing sections of the United States. This knowledge will be of value to the Bureau of Markets and Crop Estimates in formulating grades easily understood and applied by agencies engaged in the production and utilization of hay.

The Federal government, however, was once on the verge of abandoning the idea of fixing standards because of the difficulty of separating



Hay conditioning apparatus to be used to condition dry samples. Compressed air is forced into lower chamber where it takes on a load of moisture before being forced through small perforated pipes into the sample.

the grass according to kind and quality. A specially constructed table has dissipated the former difficulty. This equipment has six compartments, all within easy reach of the grader or inspector, where the various materials entering into the composition of a bale of hay are placed with respect to class. A sliding sample holding tray and a wire mesh top permit of the dirt and fine material passing to a separate compartment. An electrical oven, easily accessible to the separation table, is used for determining the moisture content of hay.

PEEL THE TIMBER

The function of the bark of a tree seems to be quite reversed when the tree is cut down. Peeled timber is more durable than unpeeled timber. One authority says that the life of timber placed in dry mine workings may be increased 10 to 15 per cent. by peeling. Bark acts as an impervious coating and retards the loss of moisture from timber, thus making the conditions more favorable to fungus attack. It also offers an excellent breeding place for many wood-destroying insects, which not only weaken the timber but cause it to decay more rapidly. Other considerations favoring peeled timber are that it usually is less inflammable than unpeeled timber, and where it must be shipped for any considerable distance by rail the peeling at the point of shipment will effect a saving in both freight and cost of handling by reducing the weight from 6 to 10 per cent. of the original green weight. Furthermore, timber which is to be given a preservative treatment must be thoroughly peeled before it can be successfully treated. Even a slight amount of the inner bark adhering to the timber will often cause imperfect treatment results.

The Journal of the Iron and Steel Institute Vol. CIV, 1921, recently issued, contains the report of the proceedings at the autumn meeting of the Institute, held at Paris, together with papers presented, and discussion and correspondence thereon. The second section of the volume contains as usual, notes on the progress of the iron and steel industries as reported in the proceedings of scientific and technical papers, together with a bibliography of the principal works dealing with the metallurgy of iron and steel, mining and allied subjects which have appeared during the last six months of 1921.



© U. S. Dept. of Agriculture.

Revolving table, designed by H. B. McClure, hay specialist of United States Department of Agriculture, used for grading hay in bale. Shadows and sidelights are thus overcome.

COMPRESSED AIR AIDS OXY-ACETYLENE WELDING JOB

SEE WHAT the cobbler can do for them." This admonition has saved thousands of pairs of shoes in the last few years and made them fit for further service at a moderate outlay. Necessity has taught us the wisdom of pocketing the difference between the price of new shoes and a worn pair skilfully renovated. The same habit of thrift may be practiced to advantage in the diversified realm of industry, and this economic fact is making a growing appeal to alert executives.

It may seem a far cry from damaged footwear to metallurgical melting pots, but an analogy does lie between them when we realize that both may be conditioned for longer use by appropriate and timely mending. The little story we have to tell may point a moral, give a hint, that may be turned to good account in divers directions in the various departments of our productive activities.

At its smelter in Kellogg, Idaho, the Bunker Hill and Sullivan Mining and Concentrating Company uses numerous cast-iron melting pots. A while back that concern had on its hands no fewer than 26 of these eight-ton vessels which were looked upon as little better than scrap because they were rather badly cracked. They had cost more than \$31,000; and as old iron their value was comparatively trifling, especially when carriage to a market and the expense of remelting them were taken into consideration. It was suggested that it might be worth while to repair them; but the question was how to accomplish this so far from a machine shop or remote from points commonly equipped to handle jobs of that kind.

The first essay to achieve this was by recourse to electric welding, but all efforts in this direction were unavailing. Gas welding was then tried, but the several attempts made along this line were likewise failures. However, tests with oxy-acetylene proved to be the most promising, and these were sufficiently encouraging to warrant further experiments. To this end, the management appealed to the engineering department of certain manufacturers engaged



Courtesy, Oxweld Acetylene Co.

The finished job.

in producing welding and cutting apparatus using oxy-acetylene, and asked the experts to devise a method suited to the special needs of the smelter pots.

The technician sent to Kellogg to tackle the problem was able to repair several of the pots so that they could be returned to service, and at the same time he showed some of the personnel how they could rehabilitate the remaining vessels. It is interesting to note that this success was not attained without a measure of pioneering, for the restoration of the pots involved the mastery of a number of difficulties. An eight-ton mass of iron is a pretty sizable lump of metal, and in order to facilitate operations it was necessary to preheat each pot. Metallurgists are fully aware that a higher temperature is required to remelt cast iron than to fuse its constituents in the first place; and a part of the work consisted in cutting a damaged area out of the heavy three and one-half inch walls preliminary to welding a replacement section.

To preheat a pot, the specialist enclosed it within an improvised charcoal furnace; but to his dismay he discovered that the simultaneous burning of 26 sacks of charcoal around

the pot did little more than warm it. It was perfectly plain that a much higher temperature was demanded. This he obtained by supplementing his charcoal fire by the blow-pipe action of a blast of oil and compressed air. To confine the heat and to concentrate it upon the pot the furnace was cloaked with a covering of asbestos paper. In this manner it was found practicable to secure that stage of preheating required before attempting welding.

When the pot had been preheated, the furnace was dismantled sufficiently to facilitate welding; and asbestos paper was laid over the hot pot to protect the worker—an opening being cut in the paper to permit access to the point where the weld was to be made. The replacement section of metal was obtained from the sound portion of another pot which was too badly burned out to justify efforts to repair it. The purpose of the preheating was to prevent the propagation of strains when the walls of the pot contracted during cooling; and the covering of asbestos, by slowing up cooling, lessened the force of the shrinkage stresses. Subsequently the pot was annealed.

As a result of the convincing demonstrations given by the representative of the Oxweld Acetylene Company, the smelting concern has since ordered a complete installation of the equipment then used, including generators for acetylene; and in the future that metallurgical enterprise will employ the apparatus not only on work of the sort described but for general welding and cutting at the mine in repairing broken and worn machinery or other plant features.

Tests which have been carried out with a system of guiding aeroplanes in fog by means of the reception of impulses from a ground cable are reported to have yielded satisfactory results. The apparatus, which has been designed by Lieutenant Loth, of the French Navy, will, it is believed, enable regular commercial flights to be made under night and fog conditions which at present render air services impossible. The pilot is able by means of the receivers installed on the machine to ascertain his position with remarkable accuracy, and it is understood that a cable will be laid on a portion of the London-Paris route in the near future.



Courtesy, Oxweld Acetylene Co.

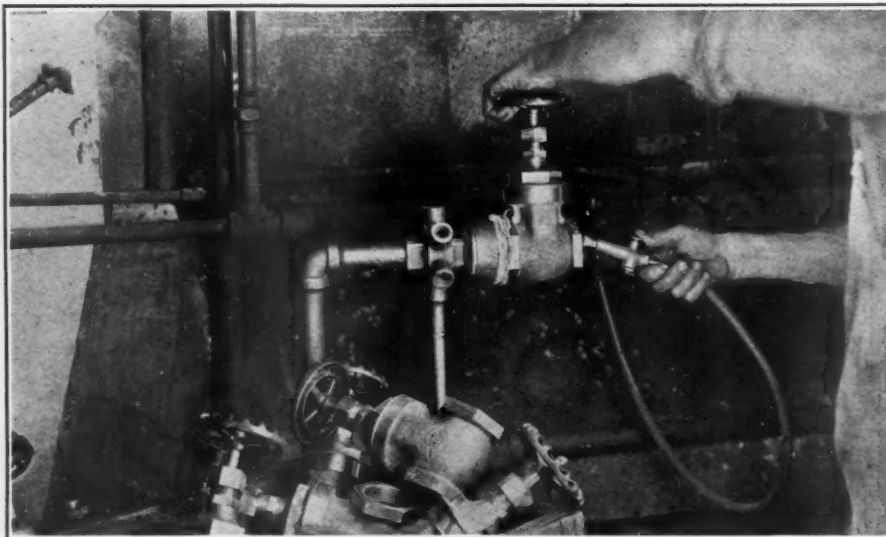
An 8-ton pot with damaged area removed preparatory to welding.



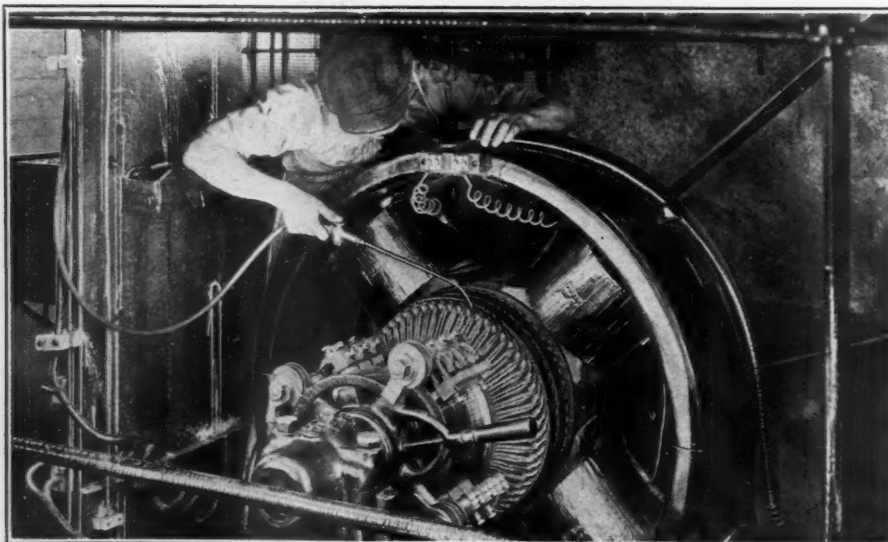
The air gun may be operated by the foot which permits the operator to use both hands on his work.



Blowing chips from the work as it is machined. The air gun is opened by a trip fastened to the turret which automatically opens it as the turret turns.



Blowing out the water remaining in a valve after it is closed, when testing, so as to determine whether or not it leaks.



A long nozzle on the gun used for cleaning places that are not easily accessible.

THE AIR GUN AND ITS USES

ONE OF the many huge grain elevators situated upon the Great Lakes had the usual trouble with the operation of electric motors owing to dust and dirt arising from the movement of such an immense volume of grain. This dust settling in the motors, was the cause of constant repairs and frequently this condition resulted in burned out armatures. One day the manager decided to obtain an estimate of the cost of these repairs, and he was astonished to find that it cost him the yearly sum of \$5,000. He immediately saw the necessity of taking steps to remove the trouble and decided upon using compressed air blow guns throughout the elevator to keep the motors free from all the troublesome particles of dust and dirt. He put in a horizontal belt driven compressor of 100 cu. ft. capacity per minute and then piped the elevator. The following year the elevator operated without burning out a single motor and made a saving of practically the cost of damages to armatures and the labor for repairs.

In another instance, and one of common occurrence in industrial plants, over one hundred motors a month were sent to the electrical shop for repair and adjustment, caused principally by dust and dirt collecting in the motors, which, when received, were found to be a mass of dirt. The frequent use of the blow gun would have materially lessened this amount of repair work.

One of our nationally known tobacco companies has within the last two years made a compressor unit a part of its standardized equipment in every one of its factories. The tobacco dust had caused so much trouble with the electric motors that the company tried out a blow gun with compressed air with such satisfactory results that this cleaning method was adopted throughout all its plants.

Many other instances in every kind of a plant could be quoted, in fact, they could be multiplied without number.

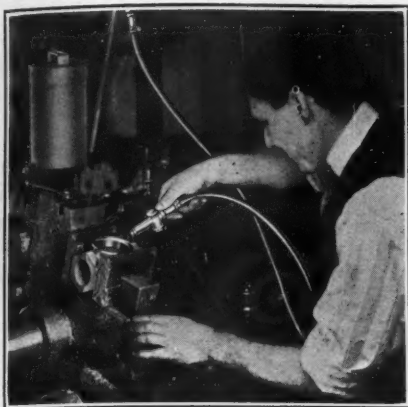
The importance of cleaning as regards output is particularly true where electrical machinery is in use. In electrical stations, power plants, car barns, etc., the air gun is almost indispensable for cleaning armatures, field coils, switch boards and controllers.

Since the introduction of the individual drive unit each machine is dependent upon the continuous operation of the motor. A large amount of dust unavoidably present in each particular industry collects on these motors and seriously impairs their operation and if not removed will result in burned out armatures.

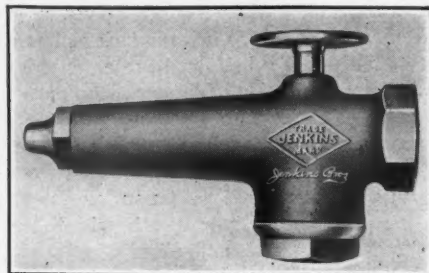
It is not uncommon for industrial establishments to have hundreds of motors in use in the different departments and consequently the cleaning problem affects the efficiency of the whole plant. The importance of keeping electrical apparatus free from dust cannot be overestimated.

Another simple but important use for compressed air in plants is for blowing dust and dirt away from inaccessible places such as rafters, timbers, trusses and other structural features which reduces the fire hazard.

Some of the different cleaning operations in addition to the above mentioned which can be



Blowing away chips during a machining operation.



Blow gun valve, fitted with Jenkins removable disc.

for cleaning is with what is commonly called a blow or air gun, or a nozzle for the end of the hose. The accompanying illustrations show one type of this device known as the Jenkins air gun which has been developed for this purpose.

A feature of this "gun" is the removable composition disc which is forced evenly and tightly against its seat under the pressure of a spring and the air itself.

In most types of gun on the market the pressure of hand or thumb on a button forces the disc from the seat which permits an instantaneous flow of air. In general the use of compressed air for cleaning has a good effect upon the workers as a dirty, ill-kept plant offers no incentive to the worker to turn out a good product and he will invariably fall into the same careless, slipshod habits as his environment fosters. On the other hand where means are provided for maintaining a clean and neat establishment the effect upon the workers is immediately noticed in the quality and quantity of the work.

That platinum has been discovered in the State of Parahyba do Norte, Brazil, is reported to the Department of Commerce by Consul Cameron at Pernambuco. The deposit is on a mountain ridge three miles from the main automobile road leading from Campina Grande to Patos. Regular truck lines now operate over this line.

advantageously performed by the use of the air gun in various industries may be summed up in the following list:

1. IN THE FOUNDRY. For blowing off cores, cleaning core-boxes, flasks, patterns; and for general dusting. Affords convenience and economy unattainable by hand bellows or brush.
2. IN THE MACHINE SHOP. For blowing out chips, borings, filings, trimmings; cleaning tools, taps, dies, reamers, lathe and bench tools, milling machines, lathes, grinders, planers, emery wheels, and benches.
3. IN WOOD WORKING MILLS. Used in saw mills, planing mills, furniture factories and other places where shavings, sawdust, dirt, dust or foreign matter must be kept from the work.
4. IN TEXTILE MILLS. Used in woolen and cotton mills, hat, clothing, and wearing apparel factories where lint, dust, or dirt must be kept from machines.
5. IN GARAGES. For cleaning automobiles, and blowing dust from cushions, bodies, and tops. A convenient way of carrying a blast of air into every "cranny and crevice."
6. FORGES. Also in forges for tempering tools, and in numerous other places where air is used for cleaning or drying purposes.

The usual method of applying compressed air



The air gun cleaning patterns of sand. This is one of the many places where it can be used in foundries and core rooms.

COPPER SHINGLE TRADE GROWS RAPIDLY

THE RAPIDITY WITH which the Anaconda Copper Mining Co. has developed its copper shingle program is a feature worthy of note reports the *Daily Metal Trade*. The first steps toward copper shingle production were taken last October. Equipment of a plant in Perth Amboy, N. J., was begun in January, and the company now is turning out 2,000 copper shingles an hour, against orders on books. Dies and other machinery were installed, also a coloring plant, which enables the company to turn out shingles in seven colors.

Recent contracts for copper shingles include the Church of the Holy Innocents, Brooklyn, N. Y.; the Twelfth Reform Church, Brooklyn, reroofing; the Clinton Avenue Congregational Church, Brooklyn; the Church of the Messiah, Thirty-fourth and Park Avenue, New York; also several country clubs and many residences. A broad foreign interest in copper shingles also has been aroused, with inquiries from China, Europe, South America and the tropics.

It has been predicted that ten per cent. of the country's roofing business will consist of copper shingles within another year or so. This is of considerable significance to the copper industry. About 30,000,000 squares of roofing are used in this country annually, according to conservative estimates. One million squares, or three and one-third per cent. of the total, would take 86,000,000 pounds of copper; ten per cent. would require over 250,000,000 pounds. Legislation in many cities against wooden shingles is expected to give impetus to use of metal shingles and the makers of metal shingles assert the relative lightness of their products is a selling point in competition with composition roofings.

The absorption of the American Brass Co. by the Anaconda company has enabled the latter to control all the processes, from ore to finished product. The copper is produced from the company's own ore, and rolled at the Ansonia, Conn., mill, whence for shingle purposes the sheets are shipped to Perth Amboy.

SUCTION CONVEYS REFUSE IN 700-FOOT PIPE LINE

When recently a lumber company in Ohio built an addition to its plant, situated at a distance of 700 ft., there arose the problem of how to handle the sawdust and refuse of both plants efficiently as a unit. The difficulty was overcome by connecting the two plants with a 15-in. pipe line. In connection with this is an air pump which conveys by suction the sawdust and refuse from each plant along the pipe line to a spout that is about 25 ft. above the roof of one of the plants. At this point there is erected on the roof a tank into which, in this way, the refuse is discharged. The tank has a hopper bottom with a discharge pipe leading from it to a point just above a side track for box cars. By this means it is loaded into the cars for shipment according to *Popular Mechanics*. The lumber company thus avoided a threatened increase in its insurance rate of from twenty to 25 per cent, and at the same time does the work more efficiently.

Compressed Air Magazine

—Founded 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:
Bowling Green Building, No. 11, Broadway,
New York City. Tel. Bowling Green, 8430

Publication Office: Somerville, New Jersey

Business Office for the British Isles:
J. F. Atkinson, Representative
No. 31, Essex Street, Strand, London, W. C. 2

TERMS OF SUBSCRIPTION

\$3 a year, U. S. A., American possessions and Mexico; all other countries, \$3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

WILLIAM LAWRENCE SAUNDERS
President

G. W. MORRISON
Treasurer and General Manager
EUGENE P. McCORKEN
Editor

ROBERT A. LUNDELL
Assistant Editor

FRANK RICHARDS
Associate Editor

ROBERT G. SKERRETT
Contributing Engineering Editor

MARY V. MCGOWAN
Editorial Secretary

JOSEPH W. SHARP
Secretary

FOREIGN CORRESPONDENTS

Paris

BEN K. RALBIGH
10, Square Desonnettes, 19 Boulevard Victor
London

ROLAND H. BRIGGS
No. 165, Queen Victoria St., E. C. 4

Vienna

HERMANN BRINKMANN
No. 3, Tuchlauben, I

Madrid

LUIS BALDASANO Y LOPEZ
No. 7, Jorge Juan

EDITORIALS

TECHNICAL LITERATURE IN THE FOUNDRY FIELD

THE PRODUCTION of iron and steel is of the greatest importance in the whole composition of American business. From the mining of the ore and in the manufacture of the multiplicity of finished products hundreds of thousands of persons are employed and the amount of business transacted each year runs into billions of dollars.

The non-ferrous metals industry is also important and a great many are employed in the different operations of alloying, casting and machining of aluminum, brass, nickel, copper, tin, lead, etc.

Our methods of foundry practice are most influential in affecting the price of the manufactured article and in making available a great many products that add to the convenience of the general public.

Compressed air has been one agency of the highest value in the foundry and therefore in this issue we present several articles that describe comprehensively the various uses of this medium for a great many operations. The advantages of using compressed air over obsolete hand methods will be at once apparent from the data contained in these articles.

It is remarkable, however, that even under modern conditions there exists a lack of knowledge in some of our industrial processes, owing to inefficient circulation of information in a particular field.

The extensive program of technical papers and reports to be read at the American Foundrymen's Association Convention on June 5 to 9 is an instance of how to properly disseminate knowledge and it undoubtedly has proved a valuable factor in promoting the best practice in American foundries. It is also noteworthy that the Convention will be international in character, and in addition to the annual exchange paper of the Institution of British Foundrymen which will be read by F. J. Cook of the British Institute, two papers are being contributed by members of the French Foundrymen's Association and one by the president of the Belgian Association of Foundrymen.

RADIO

THIS THING has come upon us so suddenly, has developed so rapidly and spread so widely that it finds us entirely without precedents for comparison or data for any forecasting. No one can tell today what will develop tomorrow in this line and nothing now will be able to surprise us. Broadcasting stations commanding the entire national area are sending out concerts, stories, lectures, sermons and the hot, live news of the moment.

And all this is gathered in from the free air, now freer than ever, by the dwellers in city apartments or amid the most rural surroundings. The hitherto isolated farmers are catching on, railroads as they rush over the land and ships far at sea are in close and instant touch with the life activities of our booming civilization.

All this is not yet quite as fully realized as here sketchily summarized simply because of the lack of apparatus for the listening-in, and the production and distribution of such apparatus is the most urgent, the most frantically booming, of all our industries and none can say how vast or protracted may be the demand. There surely never was such a wide-reaching and all embracing appeal. It was sprung upon us suddenly as a curiosity, immediately it is for the few and for the day a luxury, then inevitably it becomes a convenience for many and after that a necessity for all. It will seem after a time that life will not be worth living without it. Not only must we have the free air to breathe, but we must have also the open secrets, which it carries for our information and delectation.

Perhaps the most curious and wonderful feature of all is the absolute freedom and gratuity of it. Everybody can catch on to whatever may be going in the air without asking permission, without paying a cent or without a word of thanks, all of which makes the demand for apparatus for receiving, if for nothing more, universal and unlimited. The business of supplying this demand is a flourishing oasis in the arid waste of our accustomed bread winning occupations.

While radio as yet is not far above the amuse-

ment and pastime stage there can be no doubt but that it will develop into an important practical acquisition and a most useful accelerator of certain special accomplishment, the lines of its employment developing and opening before it as with the other notable inventions and discoveries which have preceded it. We are placed in an attitude of keen expectancy as to the developments which must still be waiting very close before us.

PROPOSED INTERNATIONAL ENGINEERING CONFERENCE

THIS IS an opportune time for American engineers to get together and take a substantial part in the great problem which now confronts us,—that of the economic rehabilitation of the world. The subject is one which distinctly appeals to the engineering profession. It cannot be handled individually or by action of any national engineering society. It calls for untied effort, and the best way for that effort to be directed on practical lines would seem to be to hold a World's Congress of Engineers, at some point in Europe in the near future. Such a Congress should be held under the auspices of the four national American societies, and the privileges of representation should be given to all the members of those societies who may wish to attend. Apart from the expression of the voice of engineers on this important subject, which would follow such a meeting, there are many added advantages. American engineers are not in close touch with those of Europe. This move might result in closer relations and perhaps in a world's association of engineers. Furthermore the public would commend the engineering profession for its interest in a subject which is outside of and larger than the ordinary grind of professional work. It would lift the engineer to higher spheres. The publicity arising from it would give credit and advantage to the profession.

REGULATING ROAD MAKING EQUIPMENT

A report recently rendered by the Joint Congressional Commission of Agricultural Inquiry brings to light the necessity of careful study of our national road building problem, and the need of obtaining experienced advice in planning this great amount of work if we are to avoid spending a large sum of money unnecessarily.

The extent to which road building is required in America, and will be in the future, is shown by the fact the Commission reports that 2,500,000 miles of rural highway will have to be brought to the standard of efficiency required by motor transportation. The Commission has very wisely recommended to Congress to proceed with this work with special reference to the farmer because of the importance of motor transport in extending the farmer's markets and in sharply reducing the cost of moving his produce.

This road building program was proposed and commenced some time ago and progress has been made toward constructing an efficient

system of highways. However, there is need for more uniform regulation and a large measure of standardization, the basis of which is coöperation between the states. The type or types of road construction depending upon location and service demands, the materials and mechanical equipment for performing the work, etc., all these details need to be generally specified if we are to reap the full benefit. For instance, many pneumatic devices have been developed within the last few years which have greatly reduced the cost of construction and expedited the work, but these devices are not in nearly as much use as their adaptability warrants. The reason is probably that it is hard to change our old methods of doing things.

It is suggested that highway engineers should investigate this situation and adapt some type of machinery to replace hand methods which will then be the accepted standard throughout the country.

INTERIOR WATER TRANSPORT TO REDUCE RAIL RATES

THE MERCHANT Marine Section of the Boston Chamber of Commerce met in Washington recently. They demanded a ship subsidy, urged the Federal government to buy and rebuild the Cape Cod Canal, demanded equality of freight rates, and opposed the St. Lawrence seaway. This is a strange position to take in view of the fact that Boston suffers because it has no water communication with the Great West.

The business of the Boston port has steadily gone down because of this handicap. An evidence of this is the fact that there is a freight differential of from two cents to seven cents a hundred against Boston and in favor of New York. As an evidence that interior water communication to the coast has an advantage in keeping down the freight rates, it is interesting to note that the freight rate on 100 pounds of steel shipped from Pittsburgh to Salt Lake City is \$1.80. This rate is only \$1.00 when the material is shipped to stay on the car, passing through Salt Lake City, perhaps, until it gets to San Francisco.

Here we see the advantage derived by building the Panama Canal, which permits the passage of deep water craft to points on the Pacific Coast. Until recently the products of the Anaconda Mines in Montana were shipped West to the Pacific, loaded on ships there, sent through the Panama Canal and up the Atlantic Coast to Perth Amboy, N. J., at a figure of from five cents to ten cents a ton less than by all rail route east. This condition did not last very long because the railroads have met the situation by a special reduction of rates.

GENERAL IMPROVEMENT IN INDUSTRIAL CONDITIONS

The increase in production in the steel industry argues favorably for a brighter future. Steel plants are operating more nearly at capacity than at any time within two years. Coke ovens are gradually resuming more normal operation and generally, the situation in iron, steel, pig iron and coke is improving.

There are many other hopeful signs that point toward permanent reconstruction, one of the most encouraging of all is that the currencies of various countries—the basis of trade—are steadily increasing in stability.

Imports and exports for the calendar year of 1921 according to recent statistics show a great decrease in value and quantity, the reduction in value being of course far greater than the reduction in volume. This was a natural result of the economic upheaval of 1920 and 1921.

During March exports to Europe aggregated \$180,000,000 compared with \$129,000,000 in February and \$199,000,000 in March a year ago.

However, it is noteworthy that in analyzing the figures, it is shown that the area of distribution of the exports from the United States was much more extended in 1921 than in 1920.

JUDGE GARY recently commenting on the foreign trade situation said:

"Export business at present is increasing and has been increasing for some time. It is getting back to where it was before the war. It is getting back to the highest point. There is reason to expect that it will increase and to expect that all our business will increase."

Another favorable factor that points reassuringly toward improvement is that the banks have been able to show much better reports because of the larger payrolls of corporations, and merchants who have been carrying charge accounts for many months are beginning to find collections easier. This is therefore, throwing more money into circulation.

Consequently the time for pessimistic sentiments has passed and it is now reasonable to look forward with an optimistic outlook for future prosperity.

PUBLICITY HELPS TO EXPAND THE METAL MARKETS

THE RECENT campaign of a large non-ferrous metal trade association to place its product before the public has been, it is known, very effectual and resulted in considerable new business. We refer of course to the Copper and Brass Research Association.

The American Zinc Institute, an older organization, has been working along similar lines and publishing literature for some time giving information to the public on various uses of zinc.

There is example after example of the success of such campaigns conducted in other industries such as asbestos, paint, yeast, aluminum, cement, molybdenum, etc.

The surest method to pursue for increasing the uses of any raw product is to tell the greatest number of people about it as often as possible and to cover every phase of its economic usefulness. This has proved itself time and time again and the results are in direct proportion to the amount of effort put forth.

Campaigns of this sort have a particular value for such industries as zinc and copper. Both of these industries are capable of much development over the present normal output, as was witnessed several years ago by the immense production during the war. The only method

to remedy the very troublesome financial element of overproduction is by much widely spread publicity about the uses of these products.

Naturally a certain investment is required but this should be made by the entire industry, no one individual or group being called upon to make the whole outlay. Inasmuch as the whole industry profits by the investment the whole industry should contribute.

Larger production and greater sales through wider publicity is the best tonic for any industry.

EXPERIMENTING TO SOLVE AIRPLANE PROBLEMS

IT IS OF general interest to know along what lines some of our foremost authorities are experimenting in order to solve the difficulties of commercial aviation, and a recent address by DR. JOSEPH A. AMES before the National Academy of Sciences is enlightening. Aeronautical problems which have baffled the best minds of the scientific world are being solved with marked success through experiments in the laboratories at Langley Field, Virginia, under the direction of the National Advisory Committee.

There are three outstanding problems in aeronautics we are told—first, to find a substitute for the gasoline engine; second, the determination of the shape and section of a wing which will improve the performance of an airplane; and third, finding out how results of experiments on models of airplanes may be applied to full size machines.

One result so far achieved has been a modification of the Liberty engine which will enable it to function by an injection of oil. This is done by increasing the size of the piston to produce a suitable compression. Air is admitted and by being rapidly compressed causes a rise in temperature sufficient to ignite the fuel which is admitted as a jet. This, it is claimed, reduces the quantity of oil required.

Furthermore, for advancing work along these experimental lines the Newport News Shipbuilding Co. has just completed a large steel tank or wind tunnel, reported to be the largest in the world, which will be used for testing models of airplanes and their parts. All the balances and apparatus in this tunnel work automatically and readings are taken through small windows.

Commercial aviation has not advanced as rapidly as was predicted during the war, and likely it will stay in this more or less quiet stage of marking time until developments will so improve the operation of the airplane that it will receive immediate general adoption. In the meantime, we will have to be content to await patiently the results of experimental research work such as Dr. AMES describes.

On the 18-mile Shandaken tunnel of the Catskill water supply system a progress of 47,367 lin. ft. (nearly 9 miles) was made in 1921, driving from twelve headings. This work represents 291,772 cu. yds. of rock excavation and 5,845 heading shots, averaging 8.1 ft. per shot.



WEALTH AND INCOME OF THE AMERICAN People, by Walter Renton Ingalls, Consulting Mining and Metallurgical Engineer; Director of the American Bureau of Metal Statistics; formerly editor of the Engineering and Mining Journal; Past President of the Mining and Metallurgical Society of America. A survey of the economic consequences of the war. 313 pages. York, Pennsylvania. G. H. Merlin Company.

THE PARAMOUNT subject of concern at the present time is, as the author has stated, the readjustment in economic conditions following the disturbances produced by the war and the misconceptions leading to an orgy of extravagance that prevailed during two years following the armistice. How long is the world, how long is the United States going to be in effecting the inevitable readjustment, is the question asked? The reply is, that the longer and more painful will be the readjustment the less we know of what has happened to us. The more we know of the facts and the intelligence with which we face them the better able shall we be to conduct ourselves.

The author's purpose in this book has been to explain the nature of the wealth of the United States and to examine comparatively the positions before and after the war. With the establishment of the facts he offers an interpretation of their meaning and an analysis of the economic consequences of the war to the American people. Means are pointed out whereby the ravages of the war may be repaired and a sound foundation laid for restoring the old scale of living and then improving it.

SERVICE STATION MANAGEMENT, by Charles L. Jones, formerly editor Ford Service Bulletin. Nine years with Ford Motor Company Service Department. Covering service merchandising methods, shop arrangement and management, stock room systems and stock record systems. 171 pages; illustrated. New York: D. Van Nostrand Company.

THIS BOOK offers a complete analysis of the successful operation of a garage, covering every detail of service station management. It suggests methods and practices that have proved valuable when used by some of the most progressive and successful automobile dealers and service stations.

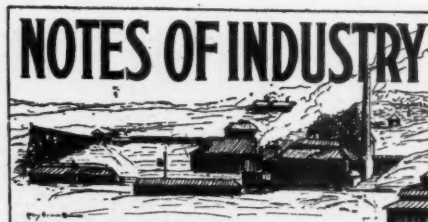
The underlying principles of service station management, as presented in this volume, are applicable by dealers and service stations handling or specializing in service on general makes of cars. However a portion of the book applies directly to Ford service stations. When it is recognized that nearly one-half of all the automobiles of the world are Fords; in the United States and Canada, a little better than half, the wisdom of this specialized information is apparent. It follows naturally that over 50 per cent. of all the service stations are either handling exclusively or specializing in Ford service.

Three definite ideas are kept in mind in presenting the information; first, to assist the

newcomer in this field; second, to assist in extending the service and operating with increased profits; and third, to serve as a guide to members of the service organization in solving their service problems.

Bulletin 10,604—Ingersoll-Rand Company, 11 Broadway, New York—describes Price Type "PO" horizontal, single cylinder, single acting, direct-injection oil engine. Probably the most outstanding feature of the design of this engine is the shape of the combustion chamber and the arrangement and construction of the spray nozzles used for direct-injection of fuel. "With this system fuel injection and complete atomization are obtained without the use of high pressure air, the ignition being at all times by the heat of compression only. Other noteworthy features are enclosed and oil-tight crank case; the pressure lubrication system for oiling all important bearings including cam rollers; the continuous filtration of lubricating oil; and the completely water-jacketed cylinder barrel and heads."

The application of evaporators to the purification of boiler feed water by distillation is covered in a general and non-technical way in a new bulletin No. 360 published by The Griscom-Russell Company, 90 West Street, New York. This booklet, which is just off the press, is so written that the application of Reilly evaporators self-scaling to the power plant for the elimination of scale, blowdown, priming, etc., can be readily understood by the non-technical executive as well as the engineer.



The scheme for the building of the submarine tunnel between England and France is now encountering a new discouragement in the extensive and constantly growing airplane traffic between the two countries. Travel by this means is now so safe and speedy and so systemized and permanently established as to greatly reduce the urgency of the demand for the tunnel. Several of the British dailies are beginning to discuss the new conditions.

It is reported that as a result of the growing lack of business in the Swiss watch and clock trade, several large works have already entirely transformed their machinery. One important works at La Chaux-de-Fonds has decided to take up the manufacture of locomotives, and has produced a model which is described as being very satisfactory.

The National Exposition of Power and Mechanical Engineering will be held at Grand Central Palace, New York City, on December 7 to 13th, 1922. The exposition will show many types of apparatus employed in the generation, distribution and utilization of power.

It is announced that a new device has been developed by the United States Navy which makes it possible readily to measure exceptional ocean depths and for navigators to take soundings as easily and as frequently as they wish. The device, which is described as simple, employs a sound apparatus similar to that developed for submarine detection during the war, the principle being the creation of a sound on board ship and the measuring of the time between this sound and the return of its echo from the bottom of the sea. The time interval, it is said, can be measured to within one-thousandth of a second.

The recent opening of the concrete paving on South Laurel street, Bridgeton, N. J., for the purpose of making a water service connection was the first time that concrete paving in Bridgeton has been disturbed since it was laid upon the streets. There had been much suggestion about the difficulty of going through concrete, reports the local paper, but this demonstration was proof that to get through the hard surface presents but a minor problem. To obtain the opening in the hard cement road covering, street commissioner, A. H. Lupton, requested the assistance of the Bridgeton Gas Light Company which has an Ingersoll-Rand air compressor, and with this machine under the direction of William Messick, one of the company's foremen, a ditch in the concrete five feet long and two and a half feet wide was opened in just twenty minutes. The balance of the ditch for the pipe was washed out under the pavement with a hose.

A railway concession has been granted to an American company which is expected to lead to important economic developments in Northern Peru, where various coal mines and petroleum seepages are known to be situated. The railway referred to will be built from Moyobamba to any point on the coast between Paíta and Pacasmayo, instead of between Paíta and Chimbote as formerly projected.

The mine from which is obtained most of the vanadium ores used in the world is situated at an elevation of 16,000 ft. in the Andes while the ore is converted into ferro-vanadium in electric furnaces near Pittsburgh. The ore contains 19-25 per cent. of vanadium and 45-60 per cent. sulphur, and is brought down to the coast by rail. As the water from the mine has a greenish color due to vanadium contained in it, a dam and recovery plant have been built on the stream that runs from the mine, and it is estimated that much vanadium will be recovered.

Radium deposits have been discovered at Valleruris, says a despatch to *Il Mondo* from Mondovi in Piedmont.

Reports from Germany indicate that a great development has taken place in recent years in the utilization of compressed air locomotives in mines. In a group of mines at Dortmund for example, in the year 1919, the number of locomotives in operation was nearly 2300, of which 624 were propelled by compressed air.

by
with
cept
to be
s th
sim
nat
ng
a son
ne tis
ts ec
e inter
hin o

aving
for the
nnecti
aving
was la
uch se
throug
this de
ough th
problem
ment ro
L. Lupt
geton Ca
rsoll-Ra
ine unde
one of th
e concre
feet wid
The bu
washed

anted to
d to lead
n North
d petrole
The rail
Moyobamb
n Paita an
Paita an

ed most o
d is situat
the Andes
ro-vanadium
n. The or
m and 45-6
down to th
ne mine ha
n containe
e been bui
mine, and
will be re

covered u
ondo from

hat a great
nt years
ocomotive
Dortmund
number of
y 2300, u
essed air.